HEADQUARTERS
DEPARTMENT OF THE ARMY

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AIR DEFENSE ARTILLERY REFERENCE HANDBOOK

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Air Defense Artillery Reference Handbook

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Preface

The purpose of this field manual (FM) is to familiarize personnel with ADA operations and weapon systems. This FM will be useful to personnel serving in the following types of positions:

- staff positions requiring general knowledge of Air Defense Artillery systems and operations
- instructor positions in service schools and the Reserve Officer Training Corps (ROTC)
- members of advisory elements and groups assigned to missions in foreign countries
- advisory positions in reserve component forces
- command and leadership positions in special operations force units
- executive positions and advisory positions that require knowledge of air defense subjects

Readers are reminded that weapons systems and operations are continually changing. Publications such as technical manuals, tables of organization and equipment, and mission training plans (MTP) provide more detailed information on specific subjects. Many of these sources are referred to in appropriate sections of this field manual.

The proponent for this manual is HQ TRADOC. Send comments and recommendations on DA Form 2028 to Commandant, USAADASCH, ATTN: ATSA-DT-WF, Fort Bliss, TX 79916-3802.

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

Chapter 1

Air Defense Artillery Mission

This chapter addresses the Air Defense Artillery (ADA) mission and the relationship to the Army tenets and battlefield operating systems. ADA contributes unique capabilities to theater counterair and theater missile defense operations as part of a joint, multinational, or interagency team. The theater objectives of ADA are to preserve combat power, gain the initiative, and support offensive operations.

MISSION

1-1. The mission of US Army Air Defense Artillery is to protect the force and selected geopolitical assets from aerial attack, missile attack and surveillance.

FORCES

1-2. ADA commanders allocate active and reserve component ADA assets based on the supported commander's priorities. In addition, the mission is broadly written to include protection of critical assets, installations, and facilities along with joint and multinational forces when required.

GEOPOLITICAL ASSETS

1-3. Geopolitical assets are nonmilitary assets that US, allied, or host nation civil authorities nominate for air and missile defense protection. These assets could be political, religious, ethnic, historical, or territorial in nature. Since protection of geopolitical assets may not directly support military operations, integration of geopolitical assets into the air and missile defense priorities list must be done at the highest levels. Geopolitical assets may include US territories.

THREAT

1-4. The threat includes all aircraft, aerial surveillance platforms, and theater missiles. Chapter 2 provides more detail and information on the threat.

CONSEQUENCES

1-5. Successful air and missile defense is key to generating and sustaining combat power in force projection operations. The AD contribution to friendly efforts to counter threat reconnaissance, intelligence surveillance, and target acquisition efforts has gained greater emphasis. Current and future Army ADA capabilities, both active and reserve component, must synergistically combine with the AD assets of other services to defeat the multifaceted threat. Army ADA forces participate in operations at all levels of war.

AIR AND MISSILE DEFENSE IN RELATION TO ARMY TENETS

1-6. Air and missile defense operations are inherently joint operations, multi-component, and embody Army doctrine. ADA forces are versatile, agile, and fight throughout the depth of the battlefield. Through aggressive planning and fully orchestrated execution, ADA allows the commander at any level to seize and maintain the initiative. Commanders integrate air and missile defense operations into campaigns fought at the operational level, and battles and engagements fought at the tactical level.

INITIATIVE

1-7. Air Defense Artillery units participate in planning for offensive and defensive counterair and theater missile defense operations. Air and missile defense commanders recommend enemy airfields, missile launch sites, command and control nodes, and logistics for deep attack. They contribute to winning the information war by destroying threat aerial reconnaissance platforms. ADA units engage air threats from directions and in ways that the enemy does not expect.

AGILITY

1-8. ADA units anticipate and counter enemy actions and react rapidly to changes in the situation. Agility is as much a mental quality as a physical one. ADA must quickly change from offense to defense, entry to decisive operations, and counterair to theater missile defense. Concentrating coverage and fires, or screening the flanks from attack and surveillance, are tasks routinely accomplished by ADA units.

DEPTH

1-9. ADA units are among the first units to deploy during force-projection operations and the last units to depart during redeployment operations. They conduct operations throughout the width and depth of the theater. ADA units achieve defense in depth using a system of systems approach, which gives multiple opportunities to defeat the aerial threat. ADA systems see deep into threat airspace to contribute to the commander's situational awareness and defeat air, missile, and surveillance threats at maximum range. Depth also includes staying power, which is the access to adequate resources to continue the fight. Army air and missile defense includes contributions from all battlefield operating systems and units.

SYNCHRONIZATION

1-10. The Synchronization tenet requires controlling the tempo of operations as well as weighting and shifting air and missile defense efforts. ADA units counter the entire aerial threat spectrum by integrating a system of systems. Commanders integrate their operations horizontally with all battlefield operating systems and vertically with both higher and lower ADA units.

VERSATILITY

1-11. ADA units meet diverse mission requirements. They require discipline, high standards, and thorough preparation. Commanders need to shift focus, task-organize, and move from one role or mission to another quickly and

efficiently. ADA units are multifunctional, able to defeat several different air threats while operating at the strategic, operational, and tactical levels.

AIR AND MISSILE DEFENSE IN FORCE PROTECTION

1-12. Commanders seek to apply overwhelming combat power to achieve victory with minimum casualties to their forces and assets. Combat power combines the elements of maneuver, firepower, protection, and leadership. Overwhelming combat power is the ability to focus sufficient force to ensure success and deny the threat any chance of escape or effective retaliation. Commanders apply overwhelming combat power by bringing all combat elements to bear at the optimum time and place, giving the threat no opportunity to respond effectively. Commanders integrate and coordinate a variety of functions with the elements of combat power. As a result, they convert the potential of forces, resources, and opportunities into actual capability through violent, coordinated action at the decisive time and place. They attempt to defeat the threat's combat power by interfering with its ability to conduct reconnaissance, maneuver, and apply firepower.

1-13. Air and missile defense makes its greatest contribution to force protection, while contributing to all four elements of combat power. Protection conserves the fighting potential of a force so commanders can apply it at the decisive time and place. Protection includes the active and passive actions units take to preserve combat power and deny the enemy the ability to successfully attack the force.

1-14. Air and missile defense operations are important active force protection measures. Offensive counterair and TMD attack operations attempt to defeat or suppress threat capabilities to launch air and missile attacks. Defensive counterair and TMD active defense destroy enemy aircraft and missiles that threaten the force.

AIR DEFENSE BATTLEFIELD OPERATING SYSTEM

1-15. Air defense is one of the seven battlefield operating systems that provide a structure for integrating and synchronizing critical combat activities in time, space, and purpose. At every echelon, commanders use the available battle command system to visualize, plan, direct, coordinate, adjust, and control the battlefield operating systems. The seven battlefield operating systems are:

- Intelligence
- Maneuver
- Fire support
- Air defense
- Mobility/Countermobility/Survivability
- Combat Service Support
- Command and Control

1-16. Battlefield operating systems exist at all echelons of command. Successful operations occur when the battlefield operating systems interact horizontally and vertically. Horizontal interaction occurs when all battlefield operating systems interact at the same echelon to maximize combat power.

Vertical integration occurs when higher and lower echelons within each battlefield operating system interact to synchronize operations. Air and missile defense commanders synchronize their operations by integrating them horizontally with other battlefield operating systems and vertically within the Air Defense battlefield operating system.

Chapter 2

Threat

This chapter describes the air and missile threats facing U.S. military forces. This evolving threat will take on new, stressing characteristics during the 21st century. Adversaries will closely observe emerging U.S. capabilities in an effort to identify and exploit weaknesses using asymmetric approaches. An asymmetric approach seeks to negate U.S. capabilities by simple counters and avoids a direct match with U.S. strengths. Fundamental capabilities that 21st-century adversaries may pursue to counter U.S. strengths include weapons of mass destruction (WMD); unmanned reconnaissance, surveillance, and target acquisition (RSTA) systems; precision strike weapons; large numbers of inexpensive rockets; land attack cruise missiles (LACM); and information warfare. Some states will rely on asymmetric capabilities as a substitute for, or complement to, large conventional forces. This trend started in the late 1980s, and is continuing today. The proliferation of low-cost, high-payoff, unmanned systems, theater missiles (TM), unmanned aerial vehicles (UAV), and large caliber rockets (LCR) is a recent trend.

THE EVOLVING THREAT

2-1. Fixed-wing aircraft and helicopters are still formidable threats, however, the trend is toward the proliferation of unmanned systems: ballistic missiles, cruise missiles (CM), unmanned aerial vehicles (UAV), and rockets. The trend toward unmanned threats is driven by cost, training, operational factors and a strategy to counter, rather than match, enemy capabilities. Potential adversaries can obtain a significant number of UAV or CM for the price of one or two highly sophisticated aircraft, without the attendant costs of training, maintaining, basing, and sustaining a manned aircraft fleet. These weapons possess inherently lethal capabilities that stress the defense of the force, and they are increasingly available on the world market. Sophisticated and rudimentary versions of these unmanned systems pose a danger to deployed U.S. military forces. TBMs and CMs can deliver WMD on deployed forces or geopolitical assets. RSTA UAVs can detect U.S. force operations and provide the basis for near real time targeting, leading to potential disruption of decisive operations. Rockets, such as large-caliber multiple rocket launchers (MRL), pose special hazards and challenges across the spectrum of operations. Traditional air threats will still exist in the world of tomorrow. Helicopters continue to pose a significant lethal hazard for ground forces. Fixed-wing aircraft continue to evolve as expensive but highly capable weapon systems.

TACTICAL BALLISTIC MISSILES

2-2. TBMs include short-range ballistic missiles (SRBM) with ranges up to 1,000 kilometers and medium-range ballistic missiles (MRBM) with ranges from 1,000 to 3,000 kilometers. These are surface-launched missiles with ballistic trajectories. TBMs, often launched from highly mobile, difficult-to-detect transporter erector launchers (TEL), have the capability to carry WMD. Most TBMs are single-stage missiles with a circular error probable (CEP) accuracy of one-tenth of one percent of their range. State-of-the-art guidance technologies in some missiles will reduce these errors to less than 50 meters. What makes tactical ballistic missiles (TBMs) threatening? TBMs are inherently difficult to defend against. Characteristics that increase TBM effectiveness include a reduced radar cross section (RCS), high terminal velocity, reduced notification time for defending forces, a variety of difficult-to-kill warheads, and an all-weather capability. The major TBM trends are increased range and improved accuracy.

2-3. Integration of global positioning system (GPS) and terminal guidance are the current focus of improving accuracy. Solid fuels and multiple staging will increase TBM payloads and ranges. Improved TBMs may target point targets. Figure 2-1 illustrates the characteristics of TBMs.

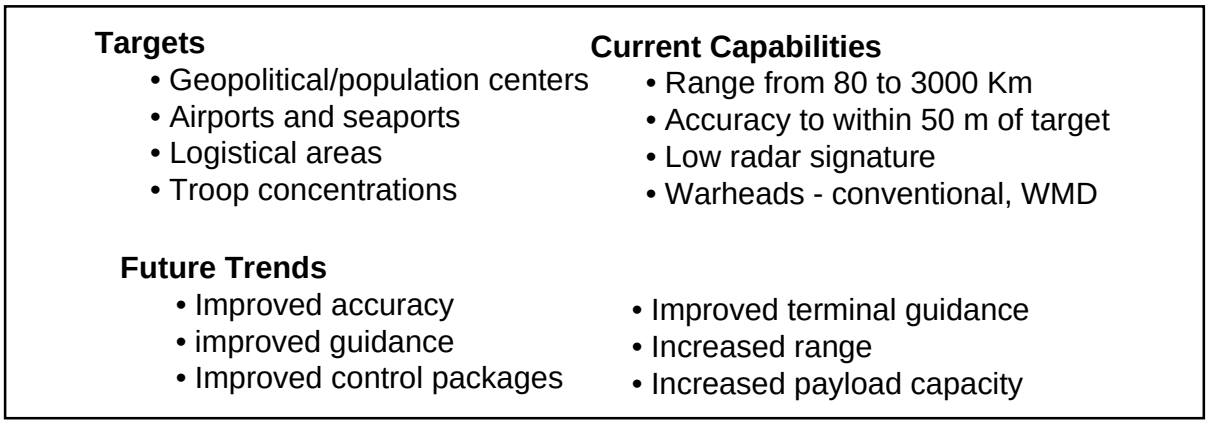


Figure 2-1. Characteristics of TBMs

LARGE CALIBER ROCKETS

2-4. Large-caliber rockets (LCR) are similar to SRBM in size, trajectory, warheads, and battlefield targets. The ability of LCR to deliver high volumes of fire and a variety of warheads makes them ideal weapon systems for fire support missions. Highly mobile launchers effectively support forward artillery missions. This mobility and the rocket's short burn time result in little warning for maneuver forces and their short-range hamper engagement by current missile defense systems.

2-5. Rockets are widely proliferated, and their production and sale is increasing. The high volume of fire and multiple warhead capabilities of LCR make them a very appealing weapon system for threat nations. In the future, threat nations may deploy passive infrared (IR) and radio frequency (RF)

warheads with these missile systems, improving their use against armor systems, command and control nodes, and battlefield radar. Figure 2-2 illustrates LCR characteristics.

Targets
- Assembly areas
- Air defense/FA locations
- Defensive positions
- Troops in the offense
- Choke points/advance routes

Current Capabilities
- High rates of fire;rapid reload
- Highly mobile(“shoot & scoot”)
- Low signature flight trajectory
- Warheads - all types

Future Trends
- Passive infrared sensors
- Advanced antiarmor warheads
- Increased range -- in excess of 150 Km

Figure 2-2. Characteristics of Large Caliber Rockets

CRUISE MISSILES

2-6. Cruise missiles (CM) are unmanned, powered, self-guided vehicles that exhibit sustained flight through aerodynamic lift at one or more predetermined, constant (cruise) altitudes and carry a warhead or other lethal payload. There are two types of CM: antiship cruise missiles (ASCM) and land attack cruise missiles (LACM). The Army is obviously most concerned with the LACM. For ease of discussion and unless otherwise noted, "CM" will denote the LACM. Cruise missiles are reliable, accurate, survivable, and lethal. They can be launched from the land, air, or sea; in flight, they are difficult to detect, can fly indirect routes (low or high) to avoid heavily defended areas, and can attack from any direction. Today's CM can hit a target with remarkable accuracy; tomorrow's smarter and more accurate CM will pose a far greater threat. Although only a limited number of LACM are currently available, numerous countries have ongoing development programs. These CM should become operational around 2000. What makes CM threatening? Emerging CMs pose serious threats because of their unique operational characteristics. The incorporation of new technologies in airframe and warhead design, propulsion systems, and guidance systems has contributed to vastly improved systems. The increased use of composite materials in airframe construction has created stronger and lighter airframes. A range of low observable and stealth technologies has reduced the RCS.

2-7. Increased use of air-breathing turbojet and turbofan engines permits subsonic speeds, providing longer ranges and flight altitudes as low as 20 meters above ground level (AGL). Sophisticated guidance systems, such as GPS, the inertial navigation system (INS), and terrain contour matching (TERCOM) contribute to overall accuracy and allow programming of unpredictable flight paths to optimize surprise. A terminal guidance seeker increases accuracy up to less than 10 meters. A wide array of conventional

warheads, to include submunitions, allows targeting of both soft and hard targets. NBC weapons pose the most serious threat, but currently very few countries have CM with nuclear warheads. However, the development of a chemical or biological warhead is not difficult. The May 1997 Quadrennial Defense Review report noted that the use of NBC weapons is a likely condition of future warfare, and that these weapons could be delivered by several means including CM. The success of cruise missiles in Operation Desert Storm led to increased interest in these systems and spurred current worldwide developments. Threat experts foresee an increase in the number of LACM within the next ten years, as well as extended ranges, improved accuracy, reduced RCS, and increased lethality. The addition of smart submunitions will allow the engagement of armored units on the move in the near future. Countermeasures and evasive maneuvers are also potential capabilities. Figure 2-3 illustrates cruise missile characteristics.

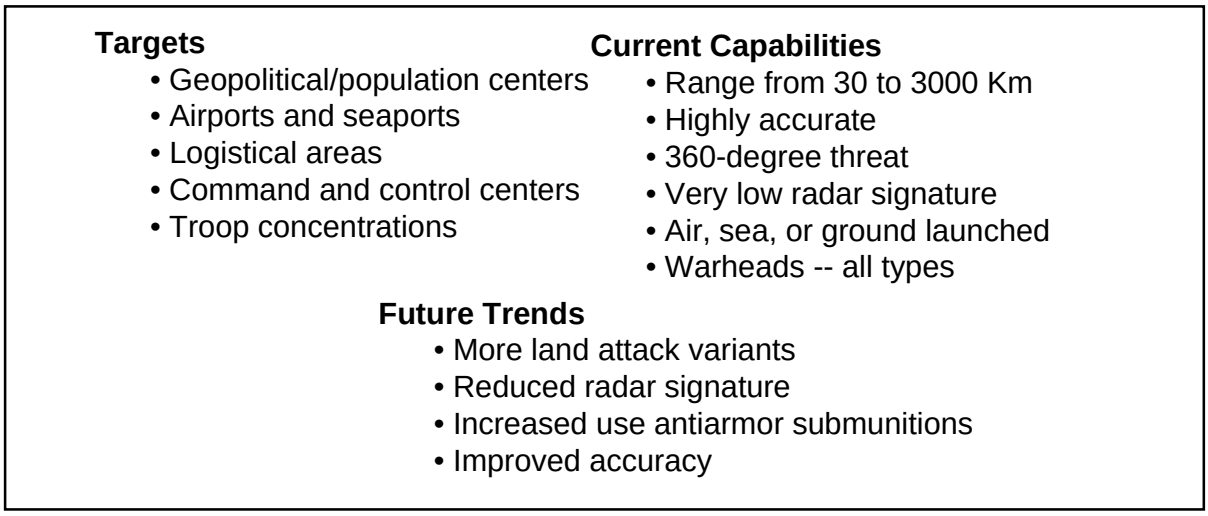


Figure 2-3. Characteristics of Cruise Missiles

AIR-TO-SURFACE MISSILES

2-8. Air-to-surface missiles (ASM) are air-launched, precision-guided munitions designed to strike ground targets. They are ideal against targets, such as bridges, that are difficult to destroy with "dumb" bombs. They are similar to air-launched CMs, but are smaller, have shorter ranges, lack the wings and aerodynamic lift associated with CMs, and are launched by tactical fighter-bomber aircraft. The former Soviet Union and free world countries widely export ASM, and they are operational in numerous air forces around the world. What Makes ASM threatening? ASM are an extremely lethal threat because of their versatility and pinpoint accuracy. Most threat ASM are of Soviet or Russian origin and employ radio command, laser, anti-radiation homing, or electronic-optical guidance systems.

2-9. Missiles that employ anti-radiation homing systems are referred to as anti-radiation missiles (ARMs); they represent the greatest threat to air and

missile defense, artillery (counter-battery), aviation, and intelligence radar. Most ARMs have ranges of over 100 kilometers. An aircraft firing an ARM will usually launch from outside the lethal envelope of the air defense system being attacked. Laser-guided systems place the attacking aircraft in harm's way because of their short range, generally less than 10 kilometers. Electro-optical or video-guided systems and ARMs offer the greatest standoff range and aircraft survivability factor. Some electro-optic systems have ranges in excess of 100 kilometers.

2-10. ASM, like CM, are becoming smarter and more versatile, reliable, accurate, and lethal. New capabilities may include a lock-on-after-launch capability or a loitering capability to attack enemy radar (for ARM variants) and may use dual mode seekers for increased reliability and combat capability. Figure 2-4 illustrates ASM characteristics.

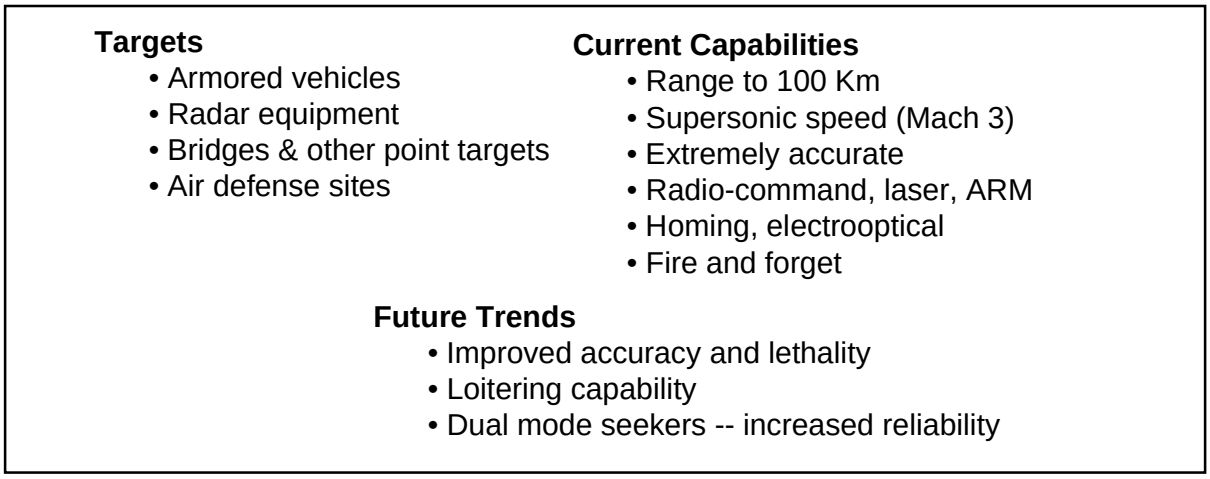


Figure 2-4. Characteristics of Air-to-Surface Missiles

UNMANNED AERIAL VEHICLES

2-11. UAVs include drones, characterized by preprogrammed flight paths and patterns, and remotely piloted vehicles (RPV), controlled by ground-based operators. Each can perform a variety of missions, ranging from reconnaissance and battlefield surveillance to attack and electronic warfare. What is it that makes UAVs threatening? UAVs serve as RSTA information platforms for target detection, identification, and location; weapon targeting; target designation; and battle damage assessment. State-of-the-art sensors and data links provide near real-time targeting for fire support systems, maneuver forces, and aircraft. UAVs equipped with laser designators provide immediate targeting of assets for attack by smart munitions. The UAV's small RCS, low speed, and small thermal signature make them difficult to detect and engage. Mission-dictated flight profiles take full advantage of terrain, increasing system survivability and optimizing coverage. Flight altitudes are normally between 1,000 to 3,000 meters AGL. UAV conducting RSTA missions fly at altitudes safe from small arms fire.

2-12. UAV payloads consist of daylight television and IR video cameras, and film cameras (for reconnaissance missions). Other major payload categories include electronic warfare (EW), electronic intelligence (ELINT), radar, and attack warheads. Several nations are developing and fielding anti-radiation homing UAV with the primary mission of attacking battlefield RF emitters (radar, communications). These platforms have a variety of launch options and are usually fire-and-forget systems. Other attack UAV systems employ terminal guidance to kill tanks or fighting vehicles.

2-13. Current projections indicate more than 50 developer countries and 75 user countries of UAVs by 2005. In addition to information gathering (still the dominant function), UAV roles will include electronic attack, decoy, ground attack, and suppression of enemy air defense (SEAD). A significant new capability involves the direct linkage of a reconnaissance UAV to an artillery unit's fire direction center. This linkage provides near real time information to ground commanders, followed by immediate fire and damage assessment. UAVs are also good candidates for stealth technology and spin-off technologies from CM developmental programs. Figure 2-5 illustrates UAV characteristics.

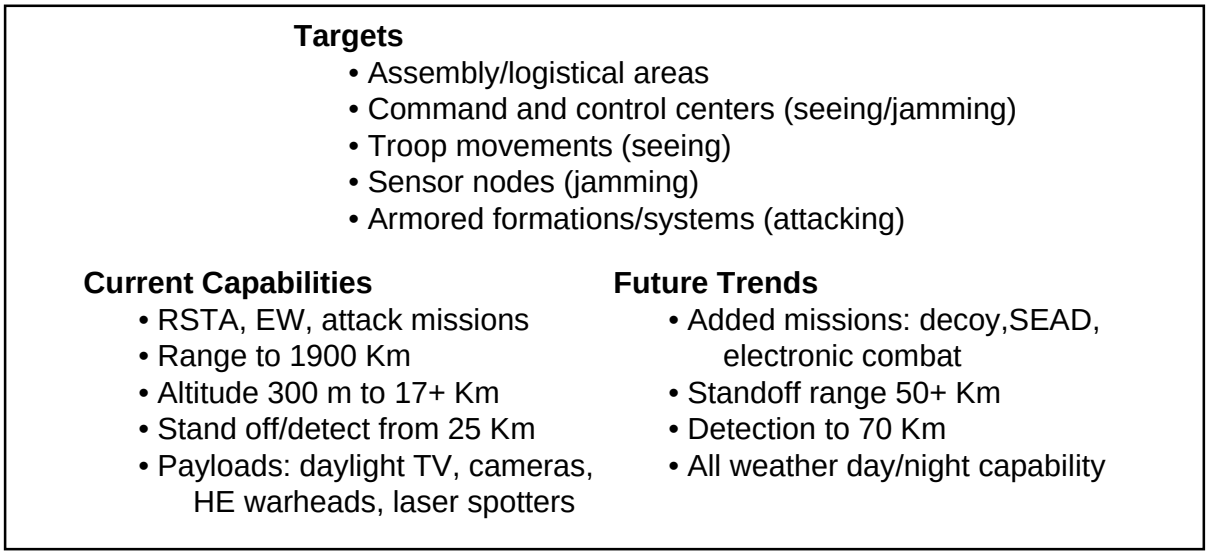

Targets
• Assembly/logistical areas
• Command and control centers (seeing/jamming)
• Troop movements (seeing)
• Sensor nodes (jamming)
• Armored formations/systems (attacking)
Current Capabilities
• RSTA, EW, attack missions
• Range to 1900 Km
• Altitude 300 m to 17+ Km
• Stand off/detect from 25 Km
• Payloads: daylight TV, cameras, HE warheads, laser spotters
Future Trends
• Added missions: decoy,SEAD, electronic combat
• Standoff range 50+ Km
• Detection to 70 Km
• All weather day/night capability

Figure 2-5. Characteristics of Unmanned Aerial Vehicles

HELICOPTERS

2-14. Most countries maintain helicopters to support military operations. The majority of the helicopters are utility systems that are, or can be, armed to perform a variety of roles, thus offering an inexpensive and effective substitute to the more expensive attack helicopter. The versatility and survivability of helicopters make them ideal for use in most combat areas. What makes helicopters threatening? Threat ground-force commanders primarily rely on helicopters to fulfill direct air support requirements. Helicopters can perform a variety of missions. Hovering and low-flying helicopters, taking full advantage of terrain masking, are difficult to acquire

and target. Better fire control and weapon capabilities will enable helicopters to search, acquire, and fire at ground targets from longer standoff ranges, thus increasing their survivability and effectiveness. Figure 2-6 illustrates helicopter characteristics.

2-15. Attack and armed utility helicopters have improved technical capabilities that focus on ground-attack capabilities using enhanced fire control and aircraft survivability equipment. The best technology trends that stand out are:

- Retrofit of existing airframes with modular upgrades.
- Modular equipment (the main focus being electro-optical sensors, weapons, and electronic attack equipment) that facilitates maintenance and reduces cost.
- Expanded night and adverse weather capabilities.
- Improved fire control systems and engagement capability (standoff hovering attacks at greater distances with much improved accuracy).
- Improved IR countermeasures against IR-seeking missiles.

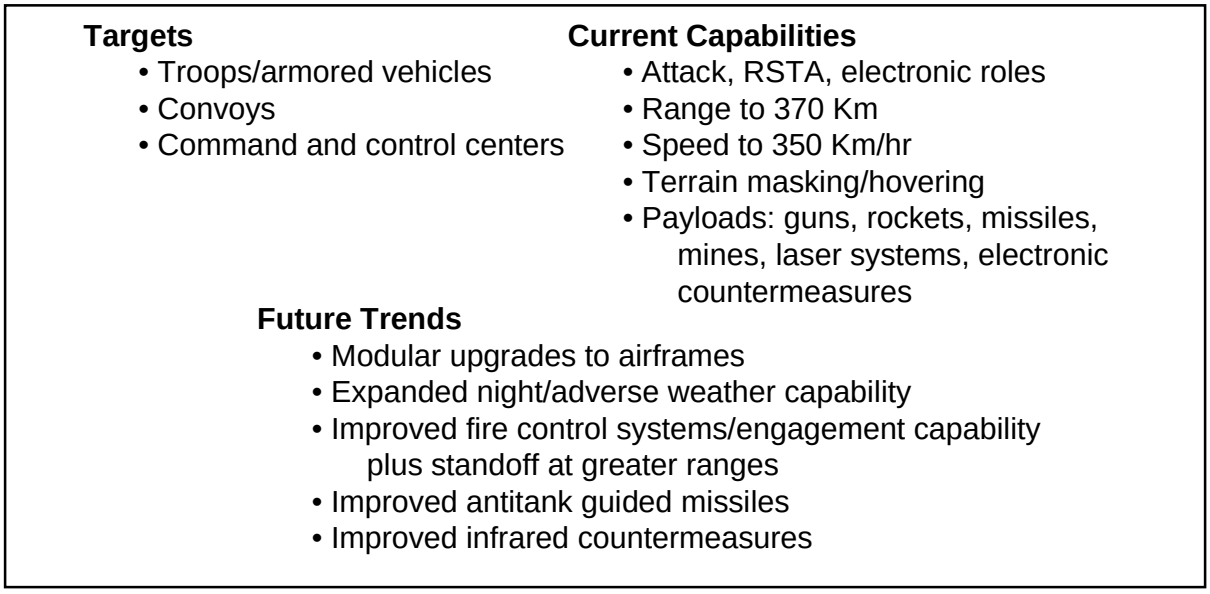

Targets
• Troops/armored vehicles
• Convoys
• Command and control centers
Current Capabilities
• Attack, RSTA, electronic roles
• Range to 370 Km
• Speed to 350 Km/hr
• Terrain masking/hovering
• Payloads: guns, rockets, missiles, mines, laser systems, electronic countermeasures
Future Trends
• Modular upgrades to airframes
• Expanded night/adverse weather capability
• Improved fire control systems/engagement capability plus standoff at greater ranges
• Improved antitank guided missiles
• Improved infrared countermeasures

Figure 2-6. Characteristics of Helicopters

FIXED-WING AIRCRAFT

2-16. Fixed-wing aircraft no longer present the most challenging threat to air defenders, however they remain a formidable threat. Coalition air power during the 1991 Gulf War provided the world with a remarkable demonstration of the capabilities of well-employed fixed-wing aircraft. There are more than 30,000 operational military aircraft today; of these, some 8,000 (many of which were Soviet produced) are in third world inventories. Some 45 countries have an aviation industry of some kind, and 21 countries design their own aircraft. While the Soviet Union was once the leading exporter of combat aircraft, today the United States, France, and Russia are the leaders.

What makes Fixed-Wing Aircraft threatening? Fixed-wing combat aircraft perform a variety of missions in both offensive and defensive operations: air interdiction, strategic attack, SEAD, and close air support. Fixed-wing aircraft can employ a variety of munitions, including guns, rockets, CM, and ASM. Integrated navigation/bombing computers and related mission equipment provide new combat aircraft with a precision-strike capability during day or night and in bad weather. In addition, new aircraft incorporate such features as radar warning receivers (RWR), on-board radar jammers, chaff, flares, and a smaller RCS to improve survivability and mission success rate.

2-17. Technological advances in low observable materials, aerodynamics, power plants, armaments, and aircraft systems has resulted in highly capable, but very expensive, aircraft. With the cost of a new fighter aircraft approaching $50 million, aircraft inventories will probably steadily decline. There will be a move toward multirole capabilities, rather than dedicated, single-mission platforms, and an increased use of precision, standoff munitions. Aircraft survivability continues to improve with incorporation of advanced EW suites, advanced countermeasures development, and reductions in radar and IR signatures. The upgrading of current aircraft capabilities will continue, rather than one-for-one replacements with next-generation aircraft. Figure 2-7 illustrates fixed-wing aircraft characteristics.

Targets

- Ports and assembly/logistical areas
- Command and control centers
- Geopolitical/population centers
- Armored vehicles/formations

Current Capabilities

- Roles: CAS, SEAD, RSTA, electronic warfare, interdiction, attack
- Precision strike
- Mission equipment: missiles, guns, rockets, bombs, WMD

Future Trends

- Multiroled versus single-mission aircraft
- Greater use of precision and standoff munitions
- Reduced radar and infrared signatures
- Integrated electronic warfare suites

Figure 2-7. Characteristics of Fixed-wing Aircraft

ELECTRONIC WARFARE

2-18. With the demise of the Soviet Union in 1991, the focus of electronic warfare against the air threat and ground based air defense has shifted from large fleets of standoff jammer aircraft to individual self-protection systems onboard fighter-bombers. This trend toward self-protection systems has extended to helicopters, and may evolve to UAVs and land attack cruise missiles (LACM) in the future.

WEAPONS OF MASS DESTRUCTION

2-19. Any nation with the will and resources can turn their legitimate nuclear, medical, and chemical industries to weapons production. This threat exists in all regions of the world, from states with long-established programs to those with emerging capabilities. Despite the dissolution of the Warsaw Pact, the downfall of communism in the former Soviet Union, and extensive efforts to negotiate treaties that would reduce the number of nuclear weapons and eliminate chemical and biological weapons from military arsenals, the number of countries pursuing NBC weapons programs continues to increase.

2-20. Russia and China currently possess nuclear weapons and there are many other nations of nuclear proliferation concern. As many as 26 countries are developing, or are suspected of developing, chemical weapons.

2-21. Principal doctrine for chemical weapons use by threat nations is to maintain the momentum of an attack and to degrade their enemy's capability to fight. Chemical and biological agents can be delivered to target areas virtually anywhere in a theater of operation. Delivery means include ballistic missiles, aircraft bombs or rockets and spray, multiple rocket launchers, mortars, conventional artillery, CM, UAV, and Special Forces.

2-22. Nuclear weapons cause casualties and materiel damage through the effects of blast, thermal radiation, and nuclear radiation. Biological agents, consisting of pathogens and toxins, produce diseases in soldiers, thereby reducing their ability to accomplish their missions. These agents are primarily an inhalation threat. Threat forces will employ chemical agents to expose soldiers to a respiratory and percutaneous agent threat by attacking with non-persistent and persistent agents. Persistent agents will also be used to contaminate personal clothing, equipment, and materiel. This will mandate the diversion of resources to decontaminate personnel and equipment.

2-23. Insurgent or terrorist groups could manufacture or acquire chemical and biological weapons to attack AD forces and other high-payoff targets. Small laboratories, such as school labs, or the drug labs used for processing cocaine, can produce some chemical and biological warfare agents.

2-24. Threat nations will employ NBC weapons to incapacitate or kill personnel. In addition, unit effectiveness decreases while operating in a contaminated environment due to fear, the requirement to wear protective clothing, and the need to decontaminate personnel and equipment. ADA units throughout the theater will be high-priority targets for NBC attack. The air defense commander and staff must, therefore, train their soldiers and units for operations in an NBC environment.

SUMMARY

2-25. Numbers of countries with the potential to present regional challenges to the United States and its allies will increase. While traditional air threats, such as fixed-wing aircraft and helicopters, will continue to improve, the acquisition of new, lower-cost, unmanned threats such as ballistic missiles, CMs, UAVs, and LCRs will add greater lethality. Ballistic missiles, in addition to being effective terror weapons, will have a more significant

military role as their range and accuracy improve. Cruise missiles are difficult to detect, highly accurate, and can attack from any direction. UAVs will add new attack, decoy, and targeting missions, though still emphasizing the traditional reconnaissance mission. LCRs, with multiple types of warheads available and long-range, high rates of fire, are another deadly threat. The use of WMD is a likely condition of future warfare, and many of the unmanned threat platforms are capable of delivering such weapons. These emerging threats present a serious challenge to ADA units. The regional proliferation of technologies and sophisticated weapons continues to grow (figure 2-8).

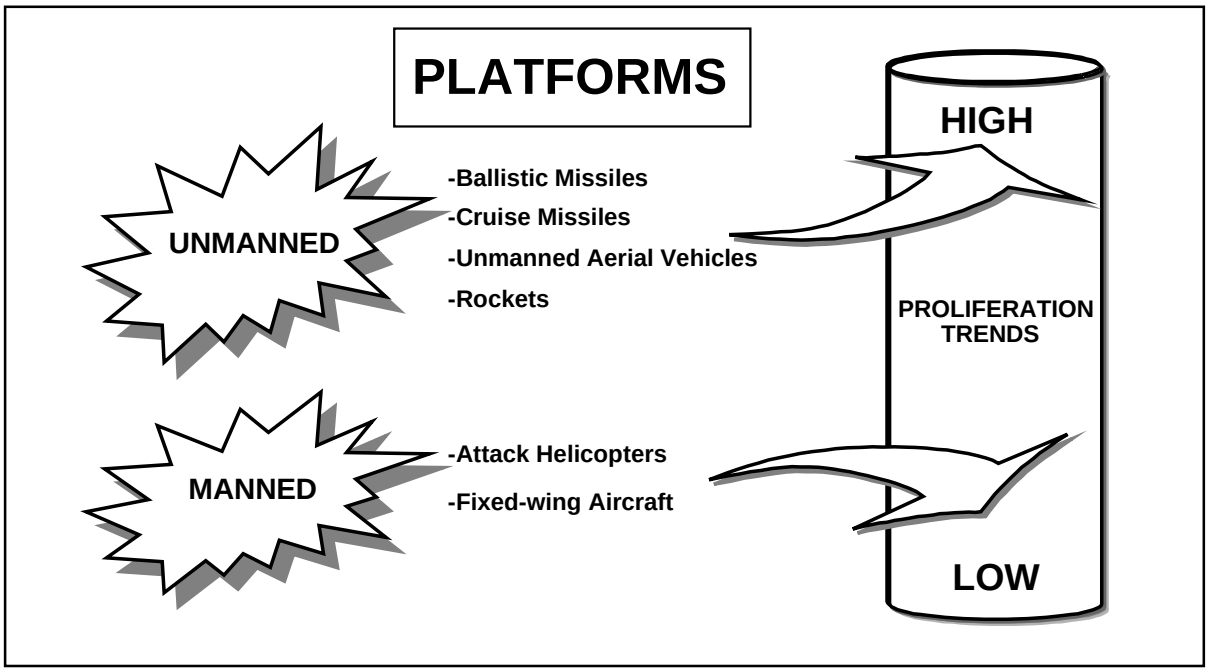


Figure 2-8. Trends in Weapons Proliferation

Chapter 3

Short Range Air Defense

This chapter provides information on short range air defense (SHORAD), systems currently in the force. SHORAD weapons are employed in support of maneuver forces. They defend personnel and assets against attack by enemy aerial platforms. They are also employed in rear areas to defend air bases, forces, key installations, and other vital assets. SHORAD systems include: Stinger (MANPADS), Bradley Stinger Fighting Vehicle (BSFV), Linebacker, and the Avenger system.

MANPADS STINGER

3-1. Stinger missiles are deployed as the missile component of the Avenger missile system, as the missile component of MANPADS teams, and as the missile component of the Linebacker. A MANPADS team is also part of the Bradley Stinger Fighting Vehicle.

3-2. The Stinger MANPADS team carries a manportable, shoulder-fired, infrared or IR/NUV seeking missile that requires no control from the gunner after firing. It has an identification, friend or foe (IFF) interrogator that aids the gunner and team chief in identifying targets. The team consists of a gunner and team chief.

WEAPON ROUND

3-3. The Stinger Man Portable Air Defense System (MANPADS) is a shoulder-fired, self-contained, close-in air defense weapon used by the United States and many foreign countries. Stinger is an infrared (IR) or infrared/negative ultraviolet (IR/NUV) seeking, fire-and-forget weapon, allowing the gunner to engage another target or take cover immediately after launch (figure 3-1, page 3-2). The system is self-contained, including its own electrical power, argon coolant, and IFF system. There are three versions of the missile: Basic, POST (Passive Optical Seeker Technique), and RMP (Reprogrammable Microprocessor). Basic Stinger has limited countermeasure capabilities, Stinger-POST has improved countermeasure capabilities, and Stinger-RMP has further refinements to its countermeasure capabilities. The RMP version has the ability to be reprogrammed to meet an ever-changing threat without hardware redesign or replacement. The RMP missile uses a two color, infrared and ultraviolet, detector and advanced algorithms to help acquire targets. This advanced capability allows the missile to effectively discriminate between targets, flares, and background clutter thereby preventing false engagements. Unlike the basic Stinger missile, the RMP has the capability to track and destroy high-performance, fixed-wing aircraft, unmanned aerial vehicles, and cruise missiles in clutter and at tactical ranges.

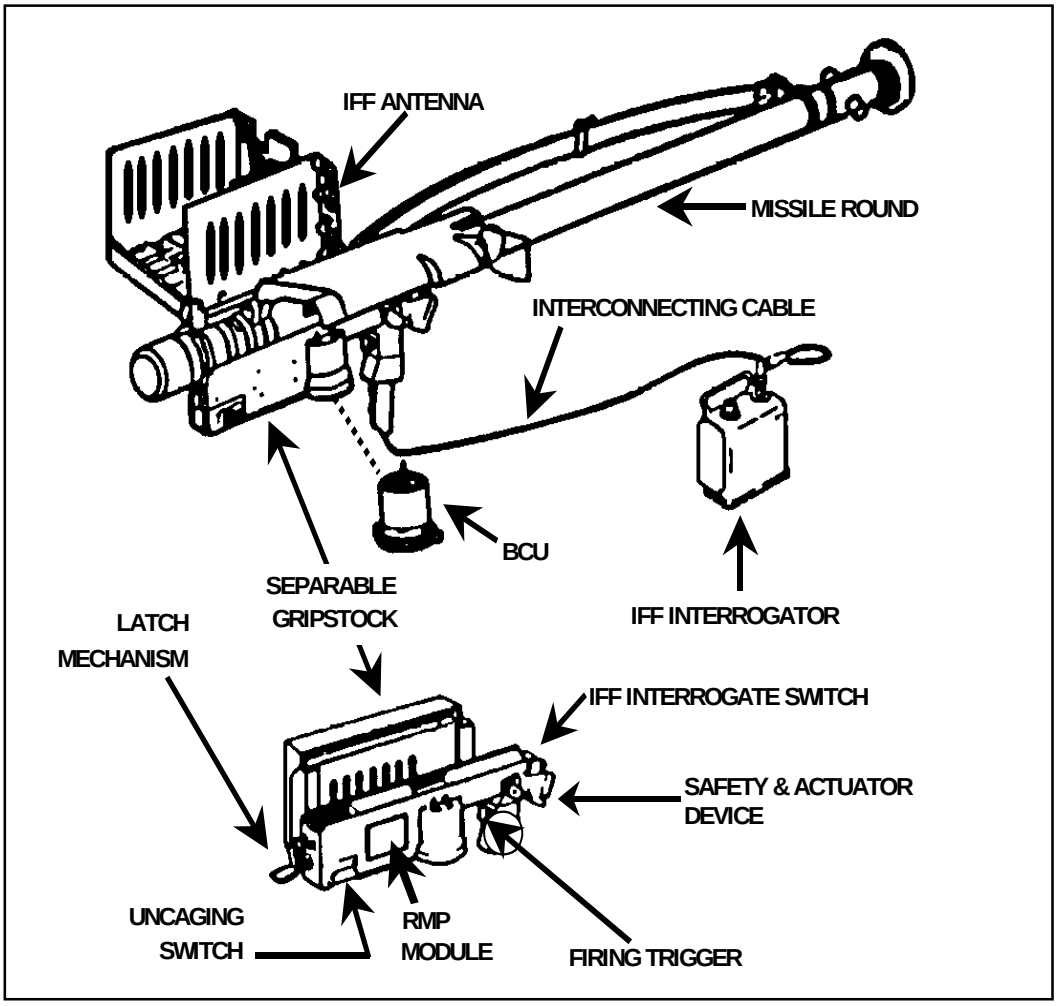


Figure 3-1. Stinger Weapon Round

MISSILE ROUND

3-4. The Stinger missile round is composed of a missile, a launch tube, and a gripstock assembly. They are described in the following paragraphs.

3-5. **Missile**. The missile consists of three sections. They are guidance section, warhead section, and propulsion section (figure 3-2, page 3-3).

3-6. The **guidance section** of the missile consists of a guidance assembly, a control assembly, a missile battery, and four controls surfaces. The guidance assembly processes target infrared/ultraviolet (IR/UV) radiation sources and provides guidance commands for the missile during flight. The seeker tracks the IR /UV source automatically after the gyro is uncaged and during missile flight. The control assembly converts the guidance commands into movement of control surfaces that direct the flight of the missile. The missile battery provides the flight power for the Stinger guided missile.

3-7. The **warhead section** consists of a fuse assembly and a quantity of explosives, all within a cylindrical case. After the flight motor ignites, the fuse arms the warhead. The fuse can detonate the warhead in three ways: by means of a low impact switch, by a hard target sensor, or by self-destructing (should target intercept not occur after launch).

3-8. The **propulsion** for the missile is provided by a separable launch (eject) motor and a dual thrust flight motor. The launch motor provides initial thrust that ejects the missile from the launch tube. It allows the missile to coast a safe distance (28 feet or 8.53 meters) from the gunner prior to ignition of the flight motor. The launch motor is expended and separated from the flight motor and falls a safe distance forward of the gunner. At separation, a lanyard attached to the launch motor pulls the shorting plug from the flight motor ignition circuit to ignite the flight motor. The flight motor provides propulsion during missile flight. Part of the propulsion system is the tail assembly. The tail assembly consists of four folding tail fins that provide roll and missile stability.

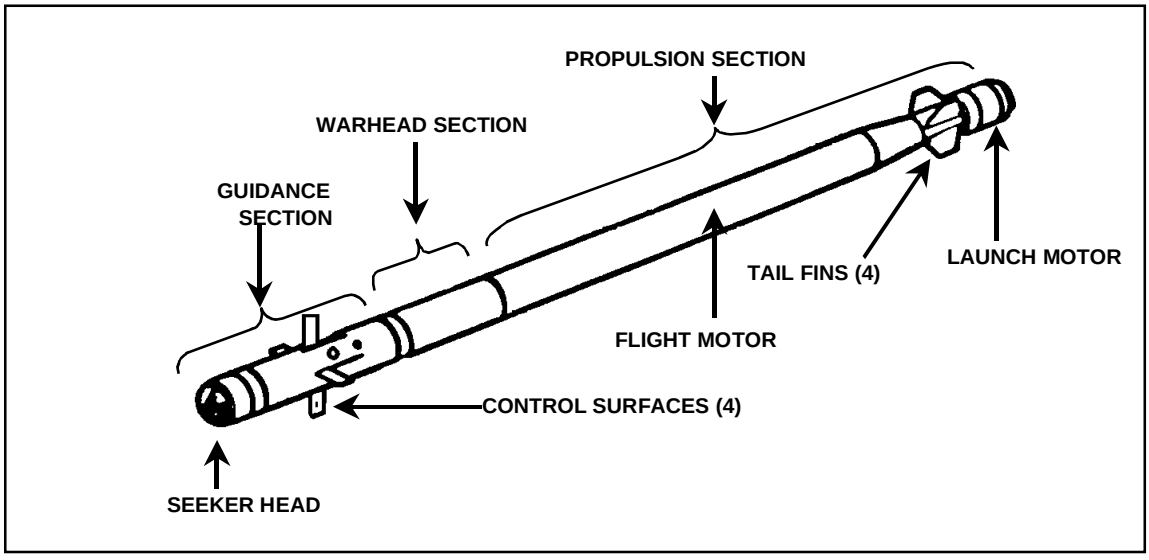


Figure 3-2. Stinger Missile

3-9. **Launch Tube Assembly**. The launch tube assembly (figure 3-3, page 3-4) is a fiberglass tube that houses the missile. It provides the means to transport, aim, and fire the missile. The launch tube provides the main support for all other parts of the weapon round. Both ends of the launch tube are sealed with breakable disks. The front disk is transparent to IR radiation, allowing the radiation to reach the heat-sensitive missile seeker. The front disk breaks outward at launch, and the aft disk blows out as the launch motor ignites. A desiccant cartridge and humidity indicator measures the humidity level in the sealed tube. The hinged sight assembly attached to the launch tube allows the gunner to sight the weapon, determine target range, superelevate the weapon, and hear the audible tones through the acquisition indicators. The eye shield attached to the sight frame protects the gunner's

left eye during launch. The launch tube is destroyed and discarded after the missile is fired.

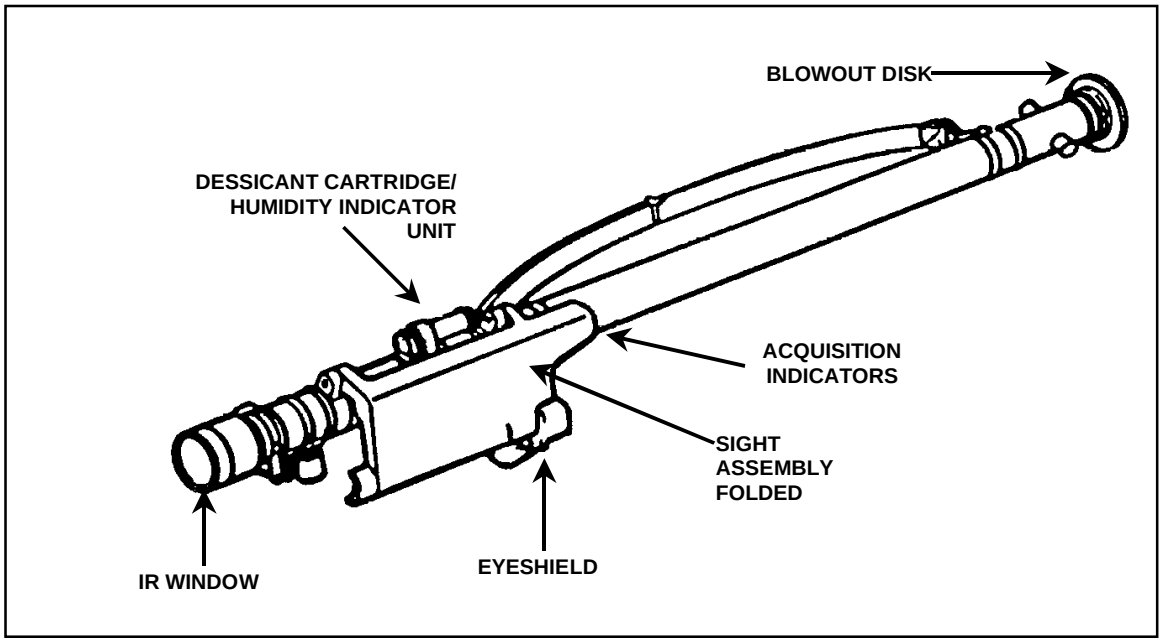


Figure 3-3. Stinger Launch Tube

3-10. **Gripstock Assembly**. The gripstock is attached to and removed from a launch tube by means of a latch (figure 3-1, page 3-2). Located on the gripstock assembly are the safety and actuator device, uncaging switch, firing trigger, IFF antenna assembly, IFF INTERROGATE switch, IFF interrogator connector, and Battery Coolant Unit (BCU) receptacle. After a missile is launched, the separable gripstock is removed from the launch tube for reuse. It can be reused until failure.

3-11. When the IFF antenna assembly is deployed and the interrogator is connected to the gripstock, it is capable of interrogating aerial platforms and receiving coded replies. After a missile is fired the IFF antenna assembly folds into a holder on the right side of the gripstock assembly.

3-12. The BCU is used to energize the weapon's electrical circuits and to cool the IR detector in the missile's seeker prior to launch of the missile. It contains a thermal battery to provide power for preflight operation, and pressurized argon gas coolant.

INTERROGATOR FRIEND OR FOE SYSTEM

3-13. Stinger is equipped with an AN/PPX-3 A/B IFF subsystem to aid in the identification of aerial platforms. The IFF system classifies aerial platforms as either friendly or unknown. It does not identify hostile aerial platforms. IFF components include the IFF interrogator and an interconnecting cable.

3-14. The gunner initiates the IFF sequence by pressing the IFF INTERROGATE switch on the gripstock assembly. The interrogator attached

to the gunner's belt sends a coded signal to the aerial platform. Once the gunner issues a challenge, the rest of the sequence is automatic.

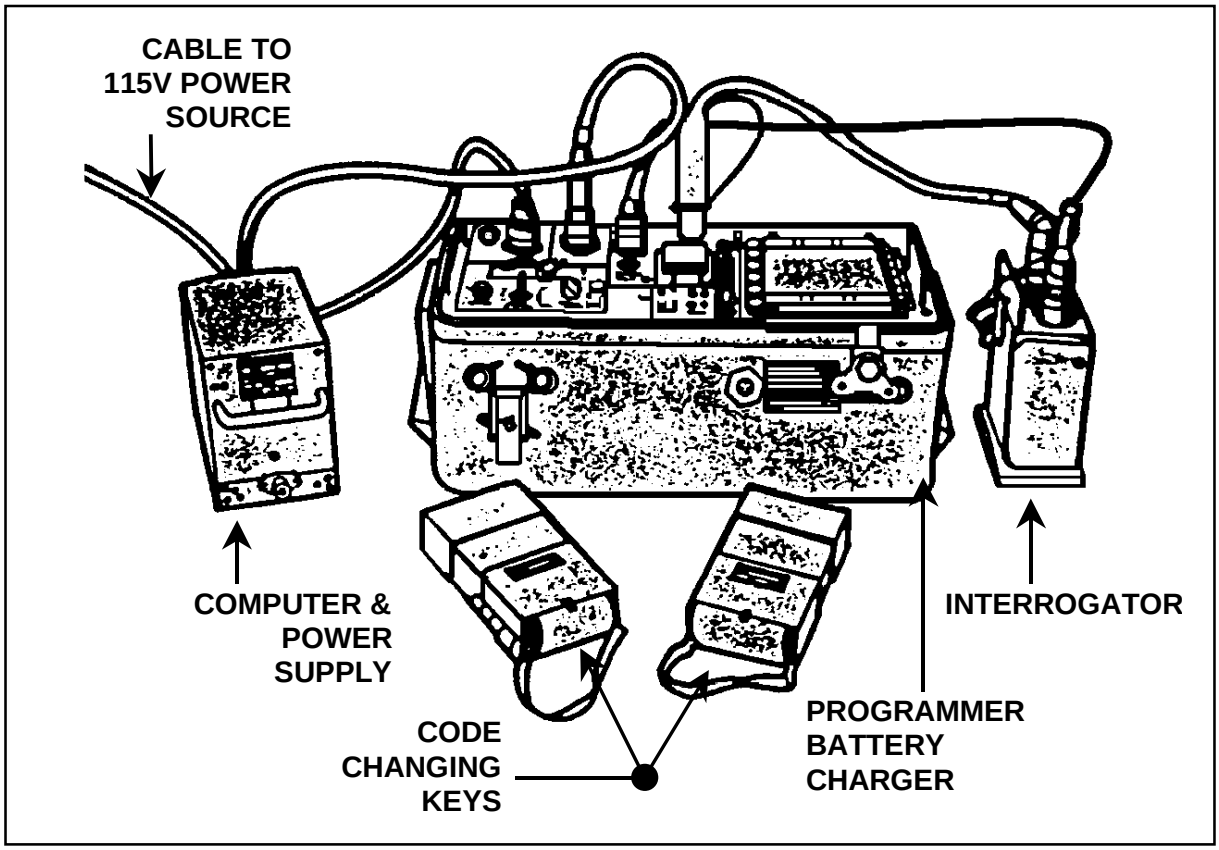


Figure 3-4. IFF Support Equipment

3-15. The aerial platform's transponder then prepares and sends a coded reply. The reply is received by the Stinger IFF antenna and is routed to the interrogator for decoding. The interrogator converts the reply into an audible tone that is then routed via the interconnecting cable to the gunner as a friendly tone. If the aerial platform's transponder sends an incorrect reply to the IFF challenge, the reply is processed by the IFF system into an unknown tone. Aerial platforms not equipped with transponders will not reply to the challenge, and this is interpreted as an unknown tone. The gunner hears the friendly or unknown tone immediately after challenging the aerial platform.

3-16. The IFF challenge is coded in Mode 4 form or Mode 3 form. A friendly Mode 4 reply is considered a true friend reply. A friendly Mode 3 reply is considered only as a possible friend reply.

3-17. Support equipment for the IFF (figure 3-4) includes a programmer battery charger AN/GSX-1, computer KIR-1C/TSEC (with power supply model ZAC A/1), and two code changing keys KOI-18/TSEC. The computer and code changing keys, when set with classified code, are classified CONFIDENTIAL, and must be safeguarded as outlined in TB 380-41. The interrogator (specifically, the reply evaluator module within the interrogator)

is also classified CONFIDENTIAL, and proper security measures must be taken for it. An IFF subsystem training set is available for training purposes. See TM 9-1425-429-12 for IFF support equipment operation instructions.

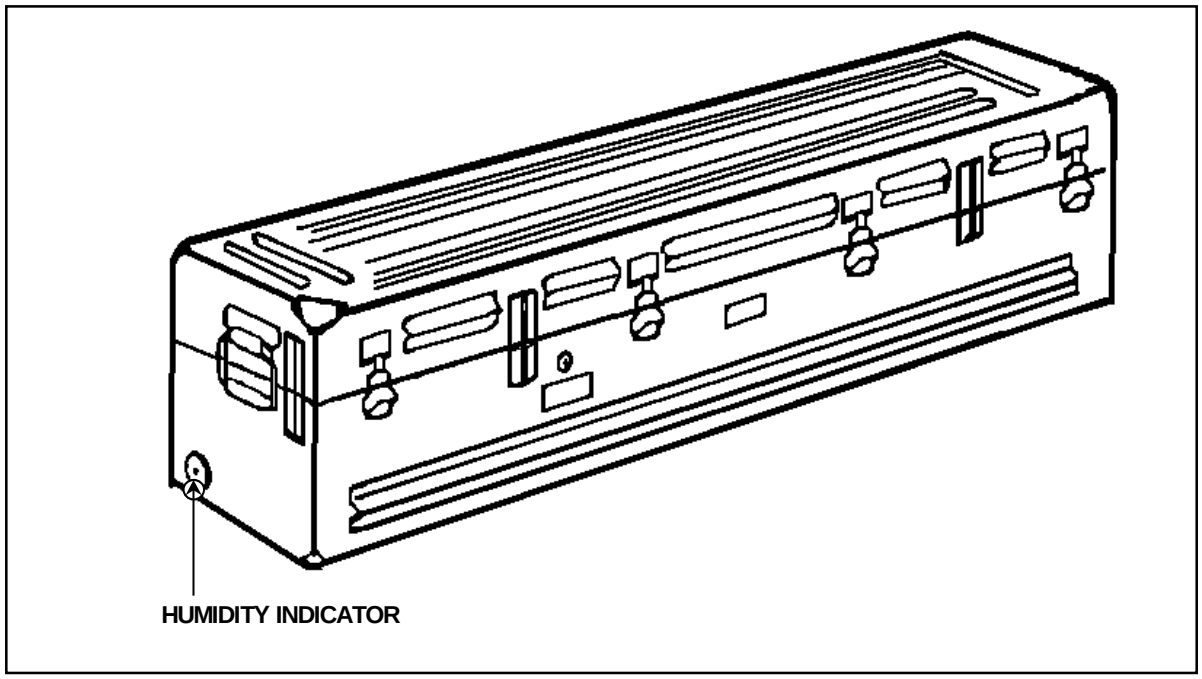


Figure 3-5. Weapon Round Container

WEAPON ROUND CONTAINER

3-18. A weapon round container provides environmental protection during shipping and storage. The container is equipped with one set of ear plugs, four latches, handles for two-man carry, a pressure relief valve, a humidity indicator, and a BCU storage area for 3 to 5 BCUs (figure 3-5).

EMPLOYMENT OF STINGER

3-19. The Stinger operates by the gunner sighting on a target. The gunner centers the target in the sight range ring. The gunner interrogates the target by pressing the IFF interrogator switch and listens for an IFF response. If the response is not a friend, he continues tracking and ranging the target. When the target is within range, he operates a safety and actuation device. When a distinct acquisition tone is heard, he presses and holds the uncaging switch. After identifying the target as hostile (aided and assisted by the team chief) the gunner will superelevate the weapon. He will then place the target in proper lead reticule and, if IR tone is still distinct, squeeze and hold the firing trigger. The gunner continues to track the target for three to five seconds. The BCU must be removed in less than three minutes after firing to prevent damage to the reusable gripstock.

3-20. Stinger's primary role is to provide Air Defense for forward combat elements against aerial platforms. Stinger defends HIMAD units, high-

priority maneuver units, and high-priority critical assets (such as command posts, trains, ammunition storage point (ASP) and POL). Stinger complements other ADA systems when priorities and the situation permit.

Employment Considerations

3-21. The following must be considered when employing Stinger:

- Aerial targets must be visually acquired.
- Aerial targets must be identified prior to firing.
- Missile back blast requires 45 meters (150 ft) of clearance behind the weapon for personnel safety.
- All personnel within 125 meters (400 feet) must wear hearing protection devices.
- To minimize the possibility of injury from flying debris do not fire with the launcher elevated more than 65 degrees or less than 10 degrees or with the aft end of the launch tube closer than 30 inches from the ground.

Stationary Point Defense

3-22. Stinger's ability to engage approaching aerial platforms makes it valuable for stationary point defenses. Its effectiveness is significantly enhanced when other ADA systems are allocated to the same defense. Teams should normally be positioned so that the engagement capability of one team overlaps that of an adjacent team. Positioning teams from two to three kilometers apart will provide this capability. In cases where more than one weapon system is employed in the same defense, overlapping fires should be achieved between weapons systems. When permitted by the tactical situation, teams must be positioned far enough out from the asset being defended to permit threat aerial platform engagement prior to ordnance release.

Mobile Point Defense

3-23. Stinger provides the ADA commander with an excellent capability to protect mobile assets to include moving maneuver units. MANPADS teams will often provide air defense for units moving in convoy or march column along roads behind the line of contact. Stinger defense of such convoys may be conducted by either pre-positioning teams along the route of march at key points such as choke points and bridges or integrating teams into the march column. When integrated into the convoy the positioning of MANPADS will depend on convoy length and available MANPAD weapons.

3-24. Early engagement by placing the gunner out and away from the defended asset is desired whenever possible. This is done so that the gunner can engage and destroy the target prior to the aerial platform reaching its ordnance release line. Gunners must be provided sufficient time to ready their weapons. When not alerted, they must have their MANPAD weapons close by, even when they are performing their own security and maintenance duties. System effectiveness largely depends on gunner reaction time. The team needs to know the weapons control status (WCS) in effect and be trained on expected threat aerial platform tactics.

BRADLEY STINGER FIGHTING VEHICLE

3-25. The Bradley Stinger Fighting Vehicle (BSFV) consists of a Bradley Fighting Vehicle transporting a Stinger MANPADS team (figure 3-6). The primary role of the BSFV is to protect forward area maneuver combat forces, combat support elements, and other critical assets from attack by hostile RW and FW aerial platforms operating at low altitudes. The BSFV can deliver effective fire against ground targets such as lightly armored vehicles and tanks using the Bradley Fighting Vehicle turret weapons.

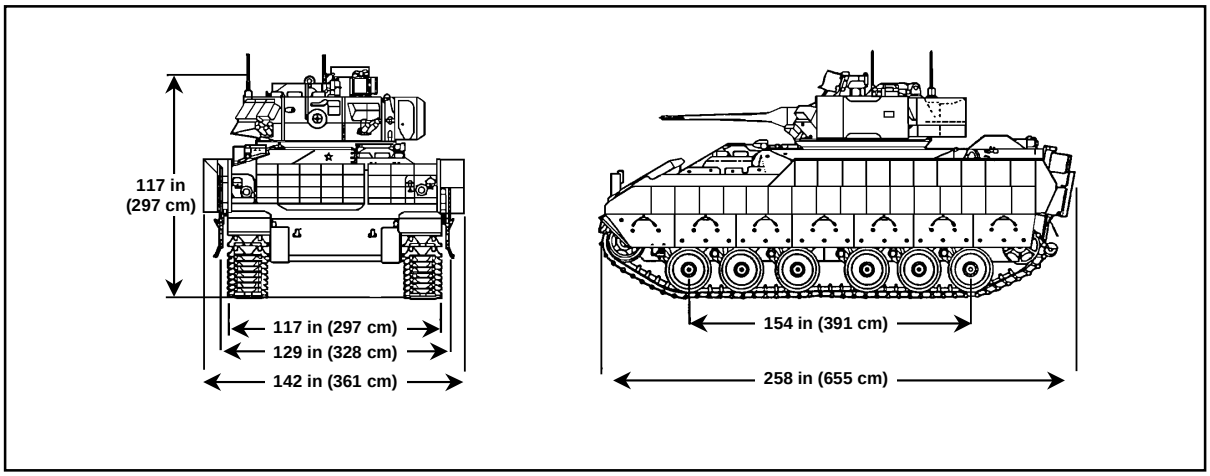


Figure 3-6. Bradley Stinger Fighting Vehicle (BSFV)

SYSTEM DESCRIPTION

3-26. The BSFV is a fully tracked, diesel-powered, lightly armored vehicle. The turret on the BSFV is equipped with a 25mm main gun, 7.62mm coaxial machine gun, externally mounted tube launched, optically tracked, wire guided (TOW) missile launcher, and two M257 smoke grenade launchers. The fire control system features an integrated day or night sight incorporating a thermal-imaging infrared device. The recommended load for missiles on the BSFV is six Stinger and five TOW missiles. Two TOW missiles are ready and three stored. All six Stingers are stored in a ready rack. Five soldiers man the BSFV (figure 3-7, page 3-10).

Table 3-1. BSFV System Characteristics

Missiles	TOW: 2 ready; 3 stowed
	Stinger: 6 stowed
Ammunition (25mm)	Armor-piercing discarding sabot-tracer (APDS-T): 70 Ready; 140 stowed
	High explosive incendiary-tracer (HEI-T): 230 Ready; 460 stowed
GENERAL	Weight (combat loaded): M2A2: 50,261 LB (22,798 kg)
	Weight (less fuel, crew, and OVE): M2A2: 43,500 LB (19,732 kg)
	Weight (air transportable): 40,775 LB (18,495 kg)
	Ground pressure (combat loaded): 7.7 psi (0.54 lg./cm^2)

Table 3-1. BSFV System Characteristics (Continued)

PERSONNEL	5 crewmembers (2 MANPADS members)
PERFORMANCE	Speed on land 41 MPH: (66/n)
	Cruising range: 300 miles (483 km)
	Turning radius: Pivot to infinite
	Slope climbing: 60%
	Side slope: 40%
	Trench crossing: 8 ft, 4in (2.5m)
	Vertical wall climbing: 36 in (9lcm)
	Gross horsepower-to-weight ratio: 20.62 hp/ton
	Ground clearance: 18 in (45.7/cm)
ENGINE	Make and model: Cummins VTA-903T
	Displacement: 903 cu in (14.8 liters)
	Type: 4 cycle
	Fuel: Diesel
	Gross horsepower: 600
SWIM FORDING	Can ford to a water depth of 36 inches

Main Gun, 25mm Automatic Gun, M242

3-27. The main armament for the BSFV is the 25mm automatic, externally powered gun. When maneuvering in the offense, the 25mm gun is used as the initial AD weapon. It is used to destroy hostile RW and slow flying FW aerial platforms, lightly armored vehicles, and to suppress enemy fortified positions. The 25mm gun is a dual-feed weapon system that allows the crew to select two types of ammunition: APDS-T and HEI-T. The 25mm gun has three rates of fire: single shot, low rate (l00 rounds per minute), and high rate (200 rounds per minute). Six basic types of ammunition are used with the 25mm gun with effective ranges up to 3,000 meters. Further information can be found in FM 23-1.

TOW Missile

3-28. TOW is a command-guided surface attack weapon that has a very limited air defense role but can be a useful alternative to Stinger for stationary and slow-moving aerial targets. TOW is used as a self-defense weapon against tanks, fortified positions, gun emplacements, and vehicles at ranges from 65 to 3750 meters (depending on type of missiles in use).

3-29. The TOW missile comes in five versions:

- Basic TOW (BGM-7lA1 extended range)
- Improved TOW (BGM-7lC)
- TOW2 (BGM-7lD)
- TOW2A (BGM-7lE)
- TOW2B (BGM-71F)

3-30. Each version is an improvement over the previous missile. Primary improvements are in the areas of penetration, effective range, and usability in adverse firing conditions. Additional information can be found in FM 23-1.

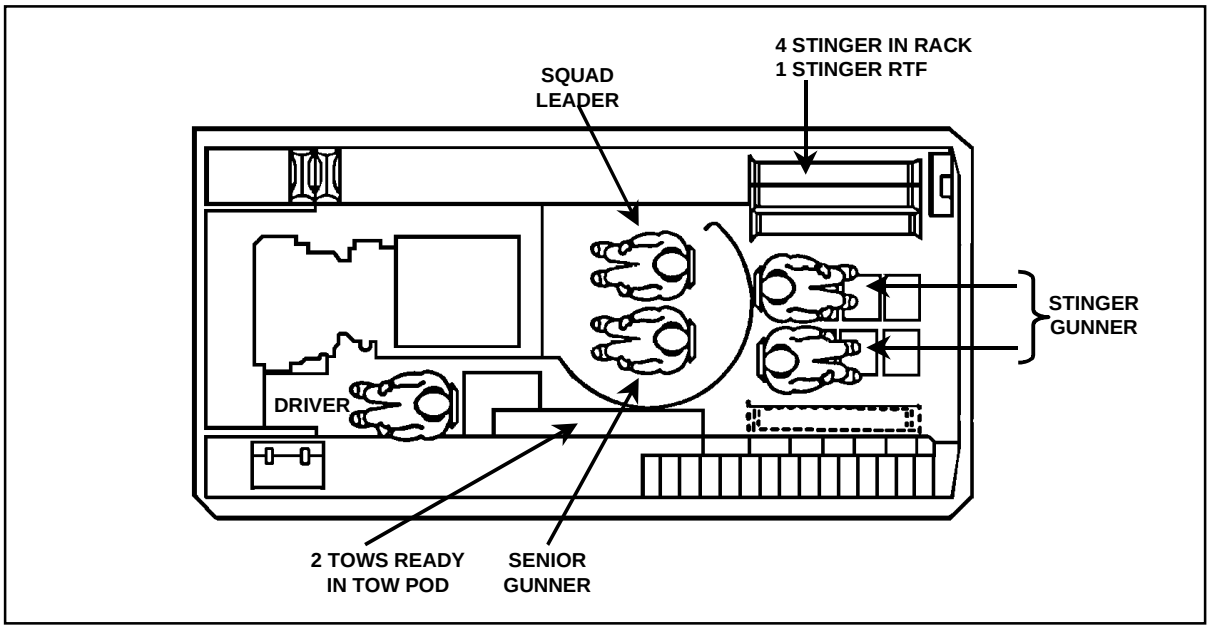


Figure 3-7. BSFV Crew

M240C 7.62 Coaxial Machine Gun

3-31. The M240C 7.62mm machine gun is a coaxial, belt-fed, gas operated, fully automatic weapon that can be used against fixed and rotary wing aerial platforms, UAVs, and unarmored vehicles. However, its maximum range of 900 meters limits its usefulness as an air defense weapon. Further information can be found in FM 23-1.

EMPLOYMENT OF BSFV

3-32. The primary mission of the BSFV squad is to defeat multiple aerial threats both moving and stationary. See table 3-2, page 3-11, for weapon usage guidelines.

Offensive Employment

3-33. BSFV units will accompany the main attack in offensive situations. When moving, or in situations with brief halts, the 25mm chain gun is the initial weapon with an effective range of two kilometers against aerial attack. Consequently, BSFVs should maneuver no further than 1000 meters apart to provide mutual support.

3-34. The Stinger team should be dismounted to provide air defense of the forces when the attacking forces are stalled or at the objective. Dismounting a Stinger team is a squad leader's decision based on the artillery threat, the ability of the FU to overwatch the maneuver force, and anticipated future movements. The Stinger can overwatch from up to one kilometer to the rear

of the defended unit. While the range of the Stinger and TOW give the platoon the ability to cover more area, they should remain within two kilometers of each other to enhance their survivability through mutual support and to mass their fires in the offense.

Table 3-2. BSFV Weapon of Choice in Tactical Employment

WEAPON	ROTARY WING		FIXED WING/CM/UAV	LIGHT ARMOR	HEAVY ARMOR
	>2000M	<2000M			
STINGER	1	1	1	NA	NA
25MM	NA	2	2	1	NA
COAX	NA	3	3	NA	NA
TOW II	2	4	NA	2	1

Defensive Employment

3-35. Bradley Stinger Fighting Vehicles establish ADA battle positions based on the IPB and the commander's scheme of maneuver in defensive situations. These positions are planned and prepared in depth to enable the use of decisive fires against attacking enemy helicopters or FW aerial platforms. Squads are positioned to maximize the Stinger's capabilities in the defense, approximately two kilometers apart.

LINEBACKER SYSTEM

3-36. The Bradley Linebacker provides the air defender with shoot-on-the-move engagement capabilities against aerial threats over the full spectrum of terrain and maneuver force operating speeds (figure 3-8, page 3-12). The Bradley Linebacker system can engage low-altitude, high-speed fixed-wing and rotary-wing aerial platforms, unmanned aerial vehicles and cruise missiles. The standard vehicle mounted launcher (SVML) for Stinger missiles replaces the TOW launcher found on the BSFV.

SYSTEM DESCRIPTION

3-37. The Linebacker crew consists of a driver, gunner, assistant gunner, and commander. The assistant gunner can reload the outer two missiles from the inside of the Bradley without being exposed to enemy fire. If the turret becomes disabled, the crew has the capability to convert to a Stinger MANPADS team.

Stinger Control Box

3-38. The Stinger control box (SCB) is the primary operator interface for the Bradley Linebacker system. It provides the controls and indicators needed to perform aerial engagements with missiles.

Bradley Control Electronics

3-39. The Bradley control electronics (BCE) is the main computer that monitors and controls all Stinger-related system functions. The primary function of the BCE is to interface between the Linebacker systems and the

operator. Through this interface, the operator provides input to the BCE that controls the Stinger system. The BCE also monitors input from the system, including built-in-test (BIT) status. If a system failure is detected, the BCE will cause the system fault indictor on the SCB to illuminate and display an error message on the control display terminal (CDT).

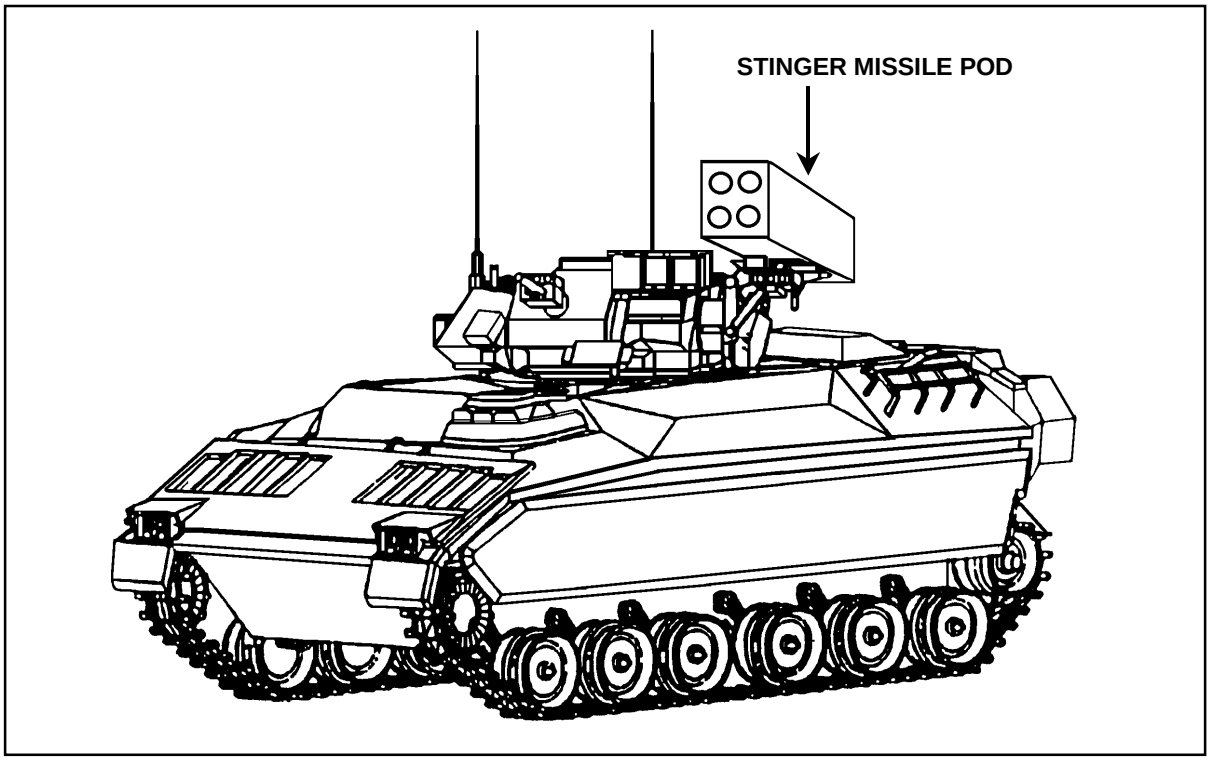


Figure 3-8. Linebacker System

Control Display Terminal

3-40. The Control Display Terminal (CDT) is a hand-held terminal mounted between the commander and gunner positions. It has an 80-character black-light liquid crystal display (LCD) and a function keypad for data input. The CDT displays essential operational information and allows the gunner or commander direct interface with the BCE.

Sighting System

3-41. The sighting system consists of a Stinger vision module (SVM) and the Stinger vision module electronics (SVME). The SVM mounts directly to the existing Bradley Integrated Sight Unit (ISU) and displays the missile status, target data, and system status to the gunner. The SVME interfaces the SVM to the BCE and displays symbology generated by the BCE.

IFF System

3-42. The IFF system components include the IFF antenna, interconnecting box, and the IFF interrogator. Targets are interrogated by pressing either

inner thumb switch forward on the gunner's hand station. The IFF antenna transmits signals from the IFF interrogator and receives the response signals from the subject target. The result of the interrogation is announced over the intercom system as a series of tones. The IFF interrogator is an AN/PPX-3B interrogator. The IFF can be dismounted to support MANPADS Stinger operations.

Missile System

3-43. The missile system consists of the SVLM and the Interface Electronic Assembly (IEA). The missile launcher holds up to four ready-to-fire Stinger missiles. It contains two argon bottles to cool down missile seeker heads, and two Launcher Electronic Assemblies (LEA) that control missile selection, gyro drive, coolant control, cycling, signal processing, and firing. Loading and unloading missiles is accomplished through upper and lower access doors. The missile launcher is mounted on a retractable platform. The platform contains an erector motor and a latch solenoid/sensor combination to ensure the platform is locked in place prior to missile firing. The launcher is mounted in an armor protective box that also provides an alignment plate for azimuth boresighting.

Command and Control

3-44. The Linebacker is equipped with the single channel ground and airborne radio system (SINCGARS), enhanced position, location and reporting system (EPLRS), precision lightweight global positioning system receiver (PLGR), simplified handheld terminal unit (SHTU) or handheld terminal unit (HTU), and slew-to-cue capability. This allows the Linebacker to receive early warning information and enables the Linebacker to accomplish early engagement.

Missile Countermeasure Device

3-45. The Missile Countermeasure Device (MCD) system is mounted on top of the turret forward of the gunner's hatch. It generates infrared radiation (IR) and directs it through the front window of the MCD unit. When the turret is turned toward an incoming antitank guided missile (ATGM), the IR causes the operation of the missile to lose electronic guidance control by sending inaccurate course correction signals. The inaccurate signals cause the missile to fly off course and crash. The MCD can defeat a variety of current first and second generation ATGMS (TOW, Dragon, HOT, Milan, AT-4-5-6-7 and Swingfire). The system effectiveness can be limited by the angle of coverage, the battlefield's haze, and any dust or mud accumulated on the system window.

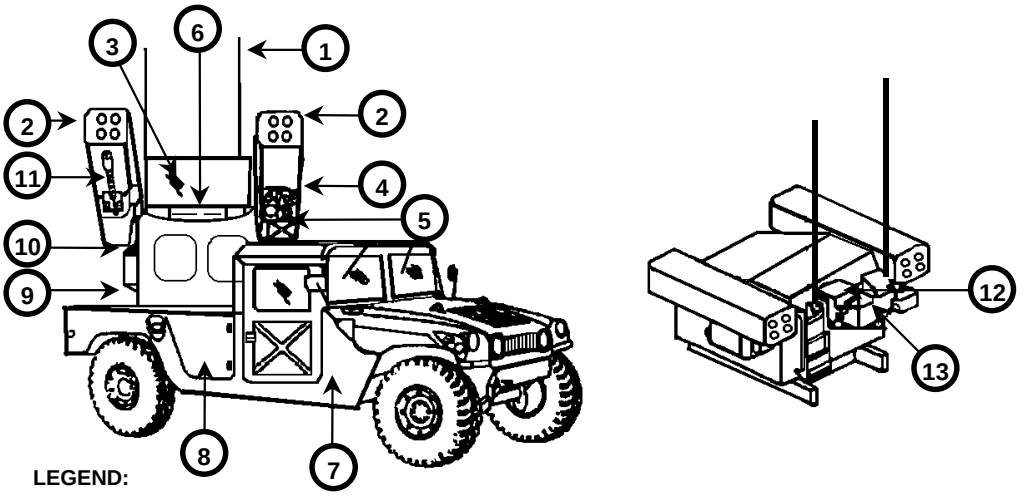
Digital Compass System

3-46. The Digital Compass System (DCS) can operate in conjunction with the PLGR or as a stand-alone system. It provides the crew with directional prompts allowing them to navigate from one point to another point more efficiently. A liquid crystal display indicates range and direction to the target, along with directional prompts. The DCS, when used in conjunction with the

laser range finder, provides the commander with the information needed to call for fire.

AVENGER SYSTEM

3-47. The Avenger weapon system is a lightweight, day or night, limited adverse weather fire unit employed to counter enemy RSTA efforts and low-level aerial threats. The Avenger plays an integral role in the combined arms team, especially with winning the information war.



LEGEND:

1. RADIO ANTENNA
2. MISSILE POD
3. CANOPY
4. LASER RANGE FINDER
5. FLIR
6. IFF ANTENNA
7. HMMWV
8. BATTERY BOX
9. AMMUNITION BOX
10. AMMUNITION CHUTE
11. MACHINE GUN
12. HEATER/VENTILATOR
13. ELEVATION DRIVE MOTOR

Figure 3-9. Avenger Fire Unit

SYSTEM DESCRIPTION

3-48. The Avenger fire unit has eight ready-to-fire Stinger missiles in two turret-mounted standard vehicle missile launchers (SVML), an M3P .50-caliber machine gun, a sensor package with forward-looking infrared receiver (FLIR), laser range finder (LRF) and IFF. It has an optical sight and digital fire control system. The Avenger is capable of firing basic, post, and RMP versions of the Stinger missile. The electrically driven gyro stabilized turret is mounted on the M1097 HMMWV. The Avenger can launch a Stinger missile or fire the machine gun while on the move or from a remote fighting position 50 meters from the fire unit (figure 3-9).

3-49. The Avenger firing sequence is entirely automated after the firing trigger is pulled. The gunner, after receiving an unknown IFF response and

having visually identified the target as hostile, will activate a missile, uncage the seeker, and, if the target is within range, fire a missile. Immediately upon firing the missile, the next missile is already spinning up its gyro and cooling down. This is done without the gunner activating the next missile. The Avenger system has the unique ability of having a backup capability of performing it's mission. Should the Avenger become disabled, the missiles in the pods can be removed, gripstocks attached, and then fired in the MANPADS configuration. Gripstocks and BCUs are stored on the Avenger during combat missions.

3-50. Onboard communications equipment consists of the Enhanced Position Location Reporting System (EPLRS) and the Single Channel Ground and Airborne Radio System (SINCGARS). The Avenger can be transported in C-130 and larger aerial platforms.

Turret (Gunner's Station)

3-51. The Avenger turret provides the gunner with unobstructed fields of fire. It can rotate through 360° degrees of azimuth and from negative 10 degrees to positive 68 degrees in elevation. The SVML pods are mounted on each side of the turret and contain four Stinger missiles each. Reload time is less than six minutes.

3-52. The Avenger turret is gyro-stabilized. A gyro is attached to the turret floor that senses changes in azimuth of the HMMWV and provides error signals to the Electronic Control Assembly (ECA) to maintain weapon pointing when in the stabilized mode of operation.

M3P .50-Caliber Machine Gun

3-53. The M3P .50-caliber machine gun is mounted on the right launch beam. It provides air defense coverage inside the missile's dead zone, and fire unit self-defense against hostile ground fire. Linked ammunition (200 rounds) is stored in the ammunition box and fed to the gun via a flexible feed chute.

Remote Control Unit

3-54. The Avenger gunner can operate the system remotely from up to a distance of 50 meters using the Remote Control Unit (RCU). The hand control switches and indicators on the RCU are the same as those on the gunner's console. Adjustments to the FLIR console cannot be made from the RCU. As the environment or weather changes, it is critical that the FLIR be kept properly adjusted at all times so that the RCU remains effective.

Sensor

3-55. The Avenger FU is equipped with a sensor system for target acquisition. The sensor system includes the Forward Looking Infrared Receiver (FLIR), the optical sight, and the Laser Range Finder (LRF)

3-56. **Forward Looking Infrared Receiver**. The Forward Looking Infrared Receiver (FLIR) provides enhanced acquisition capability in various environments: night, smoke, rain, background clutter, and haze. Once the gunner has detected and acquired the target with the FLIR, he may choose to manually track the target using the hand station, or select FLIR auto-track by pressing and releasing the right thumb switch on the hand station.

3-57. The two auto-tracking functions on Avenger are FLIR and missile. In missile auto-track, the missile seeker will lock onto the target and the turret will follow the target in azimuth and elevation, providing the Operate Mode – Track switchlight is set to Auto. In FLIR auto-track, the target must be inside the FLIR track box before pressing and releasing the right thumb switch on the hand station.

3-58. **Optical Sight**. To conduct a heads-up engagement using the optical sight, the gunner looks at the sight symbology that is being super-imposed onto the combining glass and out through the canopy. This is the same symbology that appears on the FLIR monitor, but without the auto-track reticule and NFOV fixed reticule.

3-59. **Identification Friend or Foe**. The Avenger IFF subsystem is activated by the gunner. It permits the gunner to identify aerial platforms equipped with Mode 3 or Mode 4 programmed transponders as friend, possible friend, or unknown. In normal operation the system provides a coded interrogation signal for transmission from the FU to the unidentified aerial platform. A reply is automatically generated and transmitted by a friendly aerial platform. Based on the IFF response and visual identification, the gunner either continues the engagement sequence or goes back to search/scan.

3-60. **Laser Range Finder**. Range data from the laser range finder is processed by the on-board computer and is displayed to the gunner on the Control Display Terminal in meters. The computer uses this range data to determine fire permit and lead angle information for missile and gun use. A fire permit symbol is not required to launch a missile, however it is required to fire the machine gun in the Air or Ground (Auto) mode.

OFFENSIVE EMPLOYMENT

3-61. A decision to employ Avenger fire units in support of maneuver forces requires a thorough understanding of the supported commander's intent and the establishment of disengagement criteria. Avengers may follow the brigade in zone, providing overwatch, and protecting command and control assets, reserve units, and artillery units. Planning should include the following risk considerations when deploying Avenger in support of maneuver forces. Avengers are light-skinned vehicles with a distinct high profile and are extremely vulnerable to direct fire, small arms, and indirect fire. The vehicle is unable to negotiate rugged terrain with side slopes exceeding 22 degrees.

3-62. Avengers are normally placed in a GS or GS-R supporting role. However, Avenger may be used in the direct support role, especially in light and special divisions. At night, in adverse weather and when no other ADA system can perform the ADA mission, the Avenger can be integrated into a light battalion's scheme of maneuver.

DEFENSIVE EMPLOYMENT

3-63. The Avenger platoon leader must perform a mission analysis, ensuring he understands the commander's intent and the supported unit's concept of the operation. The Avenger platoon leader must clearly understand how

Avengers will contribute to the force's air defense coverage. Based on these considerations, the platoon leader will develop a coverage plan to support the defensive concept of operations.

Chapter 4

Theater High Altitude Area Defense System

This chapter describes the Theater High Altitude Area Defense (THAAD) system. This system is deployed to defend theater and corps commanders' assets.

MISSION

4-1. The THAAD system serves as a high altitude defense against ballistic missiles. It is capable of detecting and intercepting ballistic missile threats in and above the atmosphere.

SYSTEM DESCRIPTION

4-2. A THAAD battery is made up of missile rounds, launchers, a radar, a BM/C3I segment, and ground support equipment (the FUE battery in 2006 will have 16 missiles, 1 radar, 2 launchers, and 1 BM/C3I segment). THAAD is designed to perform its mission in a centralized, decentralized, or autonomous mode of control. It will take advantage of threat data from external sources such as early warning/detection sensors and communications assets.

Radar

4-3. The THAAD radar is a high resolution, multimode, X-band, phased-array radar. It is a mobile radar system capable of being transported from site to site by aircraft and tow vehicles. The overall purpose of the radar is to identify, classify, track, and report the position of hostile vehicles to the THAAD battery Tactical Operations Center. The THAAD radar consists of several components rather than the traditional single piece of hardware: Antenna Equipment Unit, Electronics Equipment Unit, Cooling Equipment Unit, and Prime Power Unit. The radar components are all C141 aircraft transportable and are roll-on/roll-off capable on FAST ships and rail transport.

4-4. The radar uses fence, volume, and cued search modes, and provides fire control functions of surveillance, acquisition, track, discrimination, missile engagement support, and kill assessment for the THAAD system. Figure 4-1, page 4-2, shows a typical layout for the radar subsystem (the Operator Control Unit will not be a part of the fielded system).

4-5. The radar detects a potential object of interest, verifies that the detection is of legitimate interest, and initiates the track. The radar classifies the object as an air breathing threat, a TBM, or other. The radar classifies the TBMs as specific missiles such as ND-1 or SS-21. The radar identifies a threat TBM based on the predicted ground impact point. The radar provides track data concerning targets, THAAD missiles, kill vehicles (KV) and other

objects. Just prior to hand over, the radar generates target object map (TOM) data consisting of location data for the target, KV and associated objects.

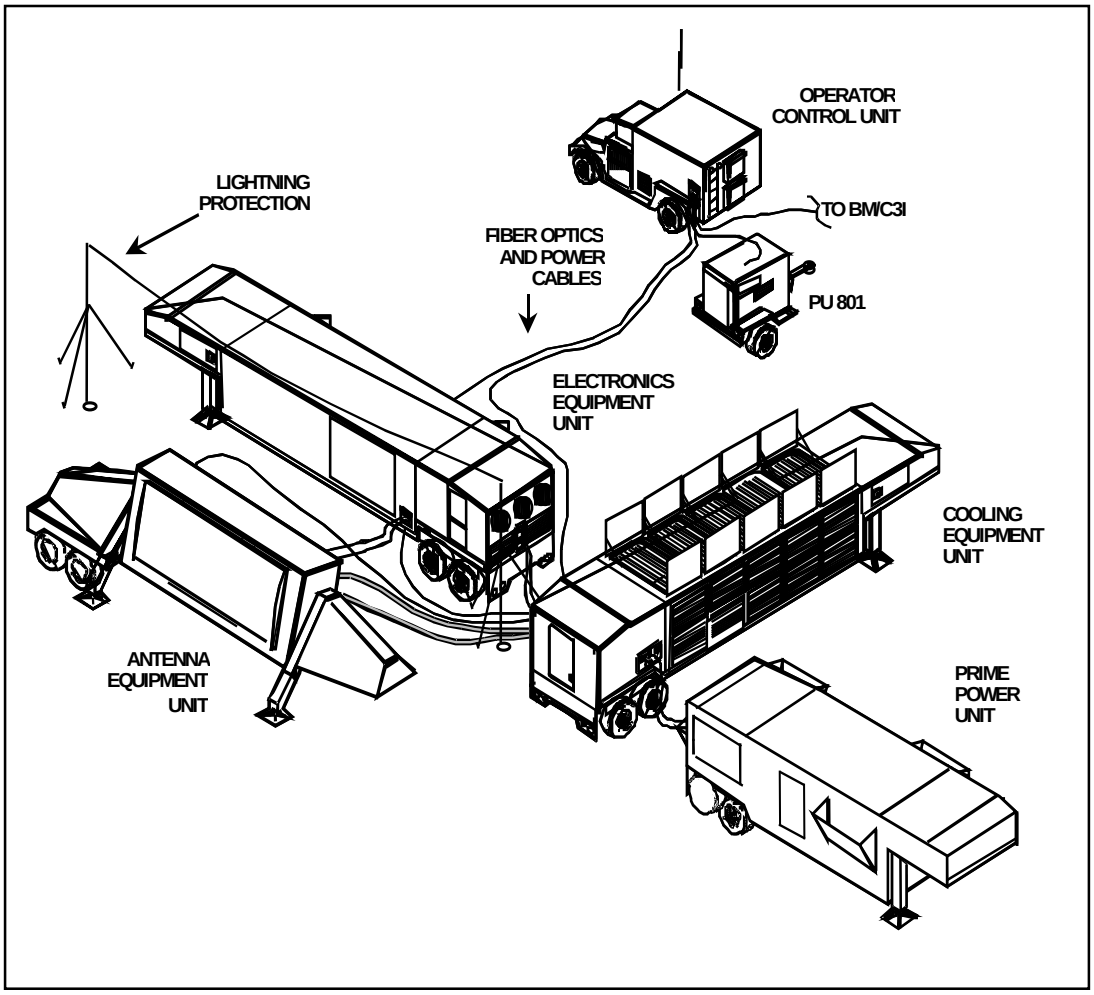


Figure 4-1. THAAD Radar Components

4-6. **Antenna Equipment Unit**. The AEU consists of an X-band, phased array antenna and an electronics package. The AE transmits radio frequency (RF) energy to support search, track, and interceptor uplink/downlink. The AE includes the capability to transmit multiple RF beams sequentially and receive beams simultaneously. The AEU has both front and rear leveling jacks. The M1088 Family of Medium Tactical Vehicles (FMTV) or a commercial semi-tractor moves the AEU. The AEU performs fence, volume, and cued search and serves as the communications link to in-flight missiles. The antenna can be positioned from zero to eighty degrees in elevation (figure 4-2, page 4-3).

4-7. The EEU provides the AEU with 208V ac uninterruptible power. The PPU provides the AEU with 4160V ac, 3-phase, 60 Hz input power and with

120/208V ac, 3-phase power via the CEU. Coolant is supplied by the CEU between 30 and 56 degrees centigrade, at a rate of 1370 liters per minute. Silicate free ethylene glycol (antifreeze) is used to cool the AEU during operation.

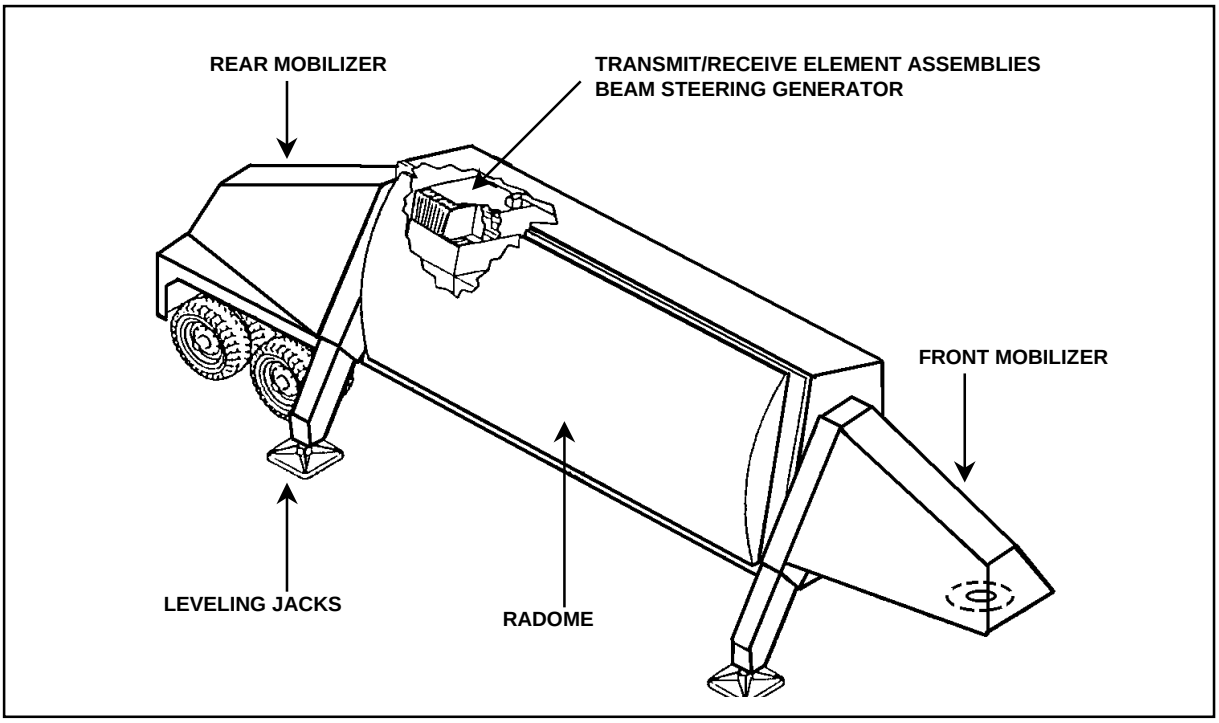


Figure 4-2. THAAD Antenna Equipment Unit

4-8. **Electronics Equipment Unit**. The electronics equipment unit (EEU) is an environmentally controlled shelter housing the electronic equipment used to generate the timing and control signals required for radar operation and signal processing. The EEU consists primarily of the receiver, recorders, and signal processor and data processing equipment of the radar. All equipment is enclosed in a trailer that is pulled by the M1088 Family of Medium Tactical Vehicles or a commercial semi-tractor with a kingpin adapter, and transported by C-141 and larger aircraft. The trailer includes an environmental control unit and an NBC vestibule and filter. The trailer has air-ride suspension on the main dolly set and the kingpin mechanism (figure 4-3, page 4-4).

4-9. **Cooling Equipment Unit**. The Cooling Equipment Unit (CEU) (figure 4-4, page 4-4) provides liquid cooling required for the AEU. It is equipped with a power distribution unit (PDU) which distributes the prime input power from the prime power unit (PPU) to the rest of the radar components. The trailer has an air-ride suspension on both the main dolly set and the kingpin mechanism. The coolant lines have quick disconnect fittings for rapid march order and emplacement. A status panel with alarm center provides status and warning of coolant overheating and fan failure. The CEU has low coolant pressure and coolant reservoir level indicators. A low temperature,

oil-fired boiler provides for fast equipment start-up. The cooling system contains a 50-gallon reservoir capacity and features an air separator for rapid voiding of air prior to supplying coolant to the AEU.

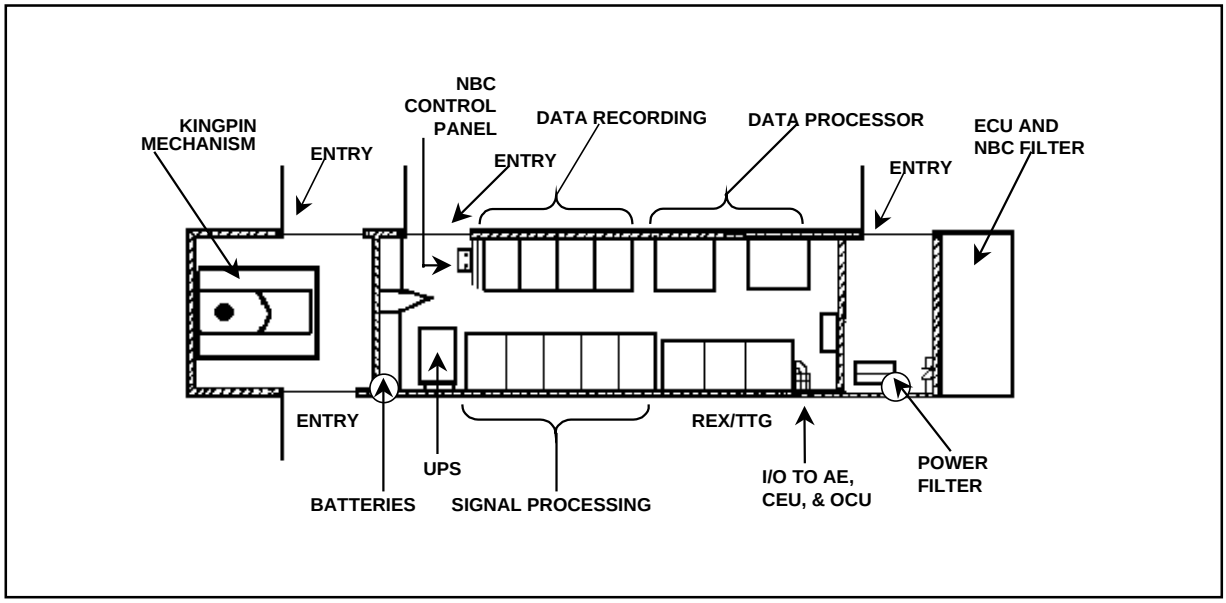


Figure 4-3. Electronics Equipment Unit

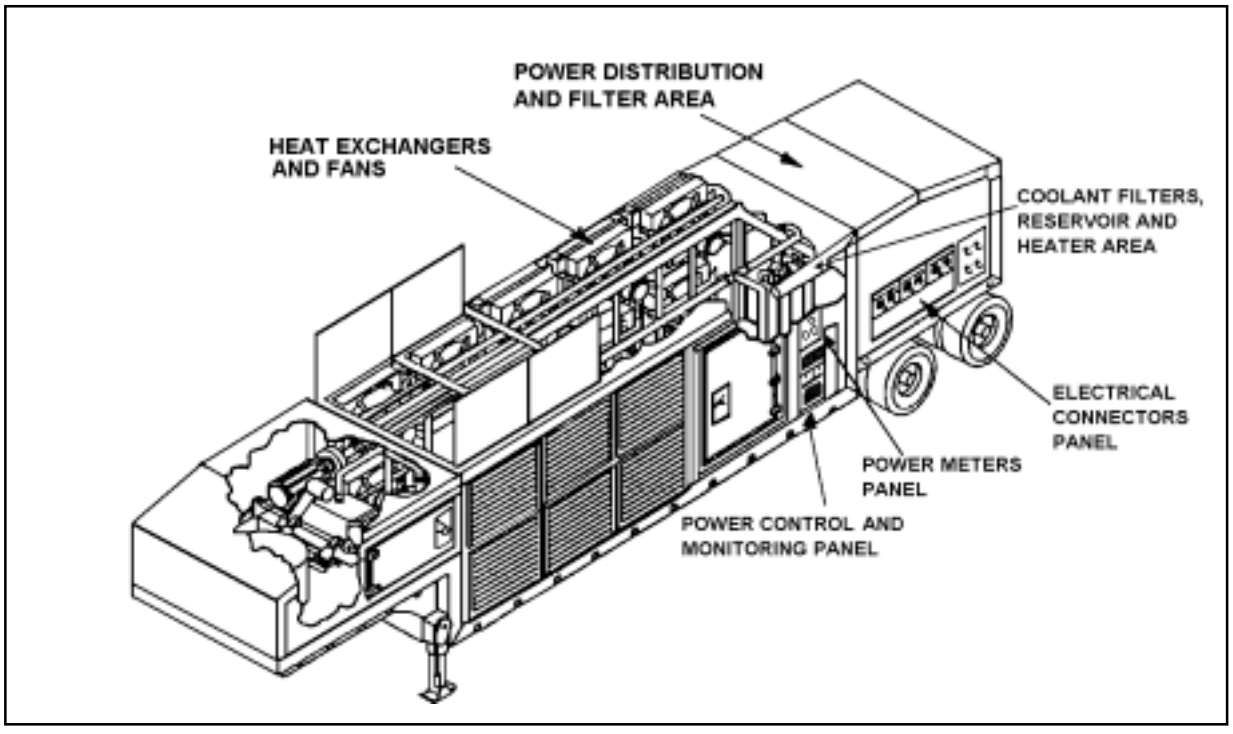

POWER DISTRIBUTION AND FILTER AREA
HEAT EXCHANGERS AND FANS
COOLANT FILTERS, RESERVOIR AND HEATER AREA
ELECTRICAL CONNECTORS PANEL
POWER METERS PANEL
POWER CONTROL AND MONITORING PANEL

Figure 4-4. Cooling Equipment Unit

4-10. **Prime Power Unit**. The prime power unit (PPU) is a transportable unit that furnishes primary AC power to the CEU for distribution to the other THAAD radar components. The PPU consists of a diesel engine,

alternator, fuel system, air intake and exhaust system, battery charging system, and associated control and interface panels. The PPU generates 1.3 megawatts of continuous 4160-volt, 3-phase power. It operates on approximately 90 gallons of JP8 fuel per hour. Military fuels compatible with the PPU engine are JP-8, JP-5, DF-1, DF-2, and JET A-1.The PPU has storage capacity for one hour of operation, and interfaces with tankers for extended operations (figure 4-5).

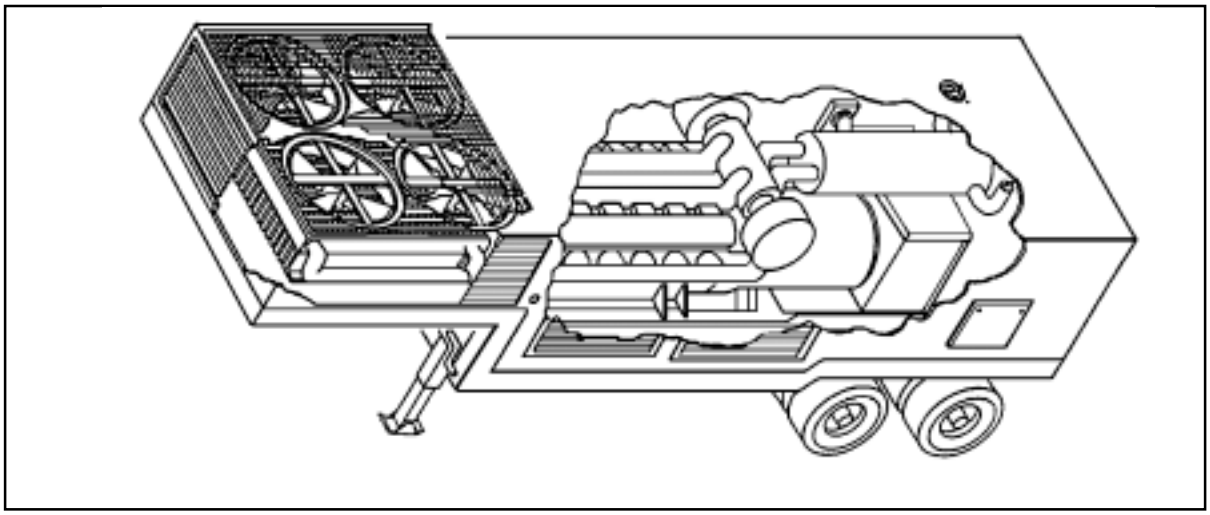


Figure 4-5. Prime Power Unit

4-11. **Operator Control Unit**. The Operator Control Unit (OCU) contains three workstations for control and monitoring of the radar. The OCU interfaces with BM/C3I, and is housed in a lightweight shelter that is mounted on a HMWWV. The OCU functions will be incorporated into the electronics equipment unit in the objective system.

Battle Management/Command, Control, Communications, and Intelligence

4-12. To accomplish the mission of conducting the air battle, commanding the forces, and exchanging information with joint forces and lower-tier defense systems, the THAAD weapon system requires a BM/C3I segment at the battery (figure 4-6, page 4-6) and battalion command levels. The BM/C3I unit coordinates and synchronizes EO and FO activities with lower-tier units, higher echelon units, and joint command centers. BM/C3I uses a netted, distributed, and replicated (NDR) architecture to ensure uninterrupted execution of engagement operations and Force operations functions.

4-13. The Battle Management/Command, Control, Communications, and Intelligence (BM/C3I) segment consists of three major components: a Tactical Operations Station (TOS), a Launch Control Station (LCS), and a System Support Group (SSG). The TOS and LCS are HMMWV-mounted shelters that are powered by trailer-mounted 15 kw generators (PU-801 series). Both have identical environmental control units and Gas Particulate Filter Units (GPFU) providing NBC protection.

4-14. **Tactical Operations Station**. The TOS is the operational module for the BM/C3I segment and contains two servers and two identical workstations. The TOS exchanges data and voice with the LCS via a high-capacity dual fiber distributed data interface (FDDI) local area network (LAN). The fiber-optic lines carry data and voice communications to the LCS. The TOS also has a DNVT that provides voice and data communications to the MSE equipment. A laser printer provides quality hard copy print out in black and white or color. An ECU provides environment control function selection and station temperature control. An uninterruptible power supply (UPS) provides a backup power source used when the primary power to the shelter is interrupted. It allows the operator 10 to 14 minutes to perform an orderly shutdown of equipment to prevent damage.

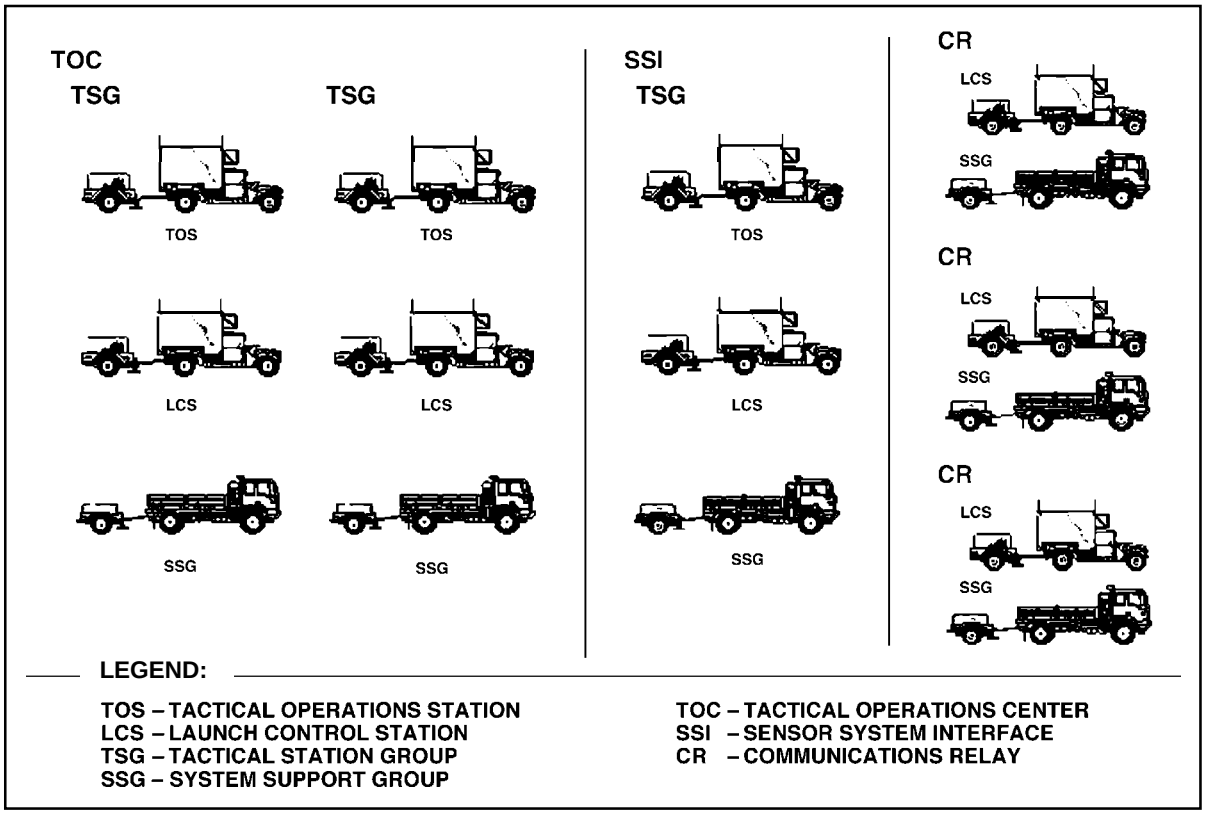


Figure 4-6. Battery BM/C3I Configuration

4-15. **Launch Control Station**. The LCS includes an M1113 Heavy HMMWV, a trailer mounted PU-801 generator, and a modified S-788 shelter equipped with an EPU. Consistent with its primary function as a multi-purpose communication element, the LCS includes the communications processing subsystem, fiber optic cable interfaces, and an extensive communications suite for internal and external tactical communications. The communications suite includes equipment to permit data communications via Tactical Digital Information Links B and J (TADIL B and J), US Message Text Format (USMTF) and the Intelligence Broadcast System (IBS). It also provides data and voice communications via the Area Common User System

(ACUS) and the AN/VRC-99, and voice communications via the Combat Net Radio (CNR). Other communications equipment includes a Global Positioning System (GPS), AN/PSC-5 Single Channel Satellite Terminal, AN/URS-5 Joint Tactical Terminal (JTT), circuit switching equipment, and Communications Security (COMSEC) device. The LCS has a roof-mounted dual batwing antenna for the CTT/H-R terminal. There are four ground-mounted antennas for the SINCGARS VHF radio sets and for the PLGR.

4-16. **System Support Group**. The SSG consists of an M-1078 Light to Medium Tactical Vehicle (LMTV) equipped with an electric crane installed in the cargo bed and a towed PU-802 generator. The SSG is also used to support fiber optics cable laying activities and to transport additional items of equipment required for THAAD Battery operations. Transported equipment includes communications ancillary equipment (e.g., antennas, antenna masts, fiber optic cable assemblies), site preparation equipment (e.g., concertina wire, camouflage netting), and soldier support items (e.g., duffel bags, rations). The generator provides a backup source of power for the TOS and LCS.

Tactical Station Group

4-17. The basic BM/C3I group is the Tactical Station Group (TSG), which consists of a TOS and LCS linked together with fiber optic cables, and a SSG. The TSG can operate independently as a communications relay (CR), or be combined with another TSG to form a battery or battalion tactical operations center (TOC). A TSG can be attached to a remote radar site where it functions as a sensor system interface (SSI). These various functional groups are discussed in the following paragraphs.

4-18. **THAAD TOC**. The THAAD TOC normally consists of two Tactical Station Groups (TSG). Although all necessary TOC functions can be accomplished using one TSG, to ensure against total system failure during the ballistic missile battle a second TSG shadows the first TSG. The THAAD TOC may be configured as follows:

- **Alternative #1 (two TSGs)**. One TSG performs engagement operations while another TSG performs force operations and provides hot back up for engagement operations (normal configuration).
- **Alternative #2 (two TSGs)**. One TSG performs engagement and force operations while another TSG is a hot back up for both engagement and force operations.
- **Alternative #3 (one TSG)**. One TSG performs engagement and force operations without a back up.

4-19. **Sensor System Interface**. The SSI is a TSG configured with a subset of TOC functionality to provide remote radar management. The SSI provides the interface between the remote radar and the EO/FO TSG. The SSI provides direct sensor tasking and management functions for its associated radar in response to direction from its EO/FO TSG.

4-20. **Communications Relay**. A CR (group) consists of a single LCS and SSG. It provides both data relay and voice relay whenever point to point

communications capabilities are exceeded because of distance or terrain masking. A CR may be used to provide communications relay between:

- **TOC and Launchers.** In exercising control of any remote THAAD element via a CR, communications between the TOC and the CR are usually via JTIDS. Communications between the CR and launchers is by fiber optic cable.
- **TOC and SSI**. In exercising control of remote radar via a CR, communications links between the TOC, CR, and SSI are usually via JTIDS.
- **THAAD TOCs**. The communications link between two or more THAAD TOCs using CRs is usually via JTIDS.
- **TOC and external agencies or nets**. The communications link between a TOC and CR is usually JTIDS with the link between the CR and external agencies/nets as required. A TOC may communicate directly with external agencies without using a CR.

Launcher

4-21. The purpose of the launcher is to provide a platform for elevating and launching missiles. The THAAD launcher consists of a modified U.S. Army model M1075 Palletized Load System (PLS) truck, missile round pallet (MRP), electronics module, generator, and battery pack (figure 4-7).

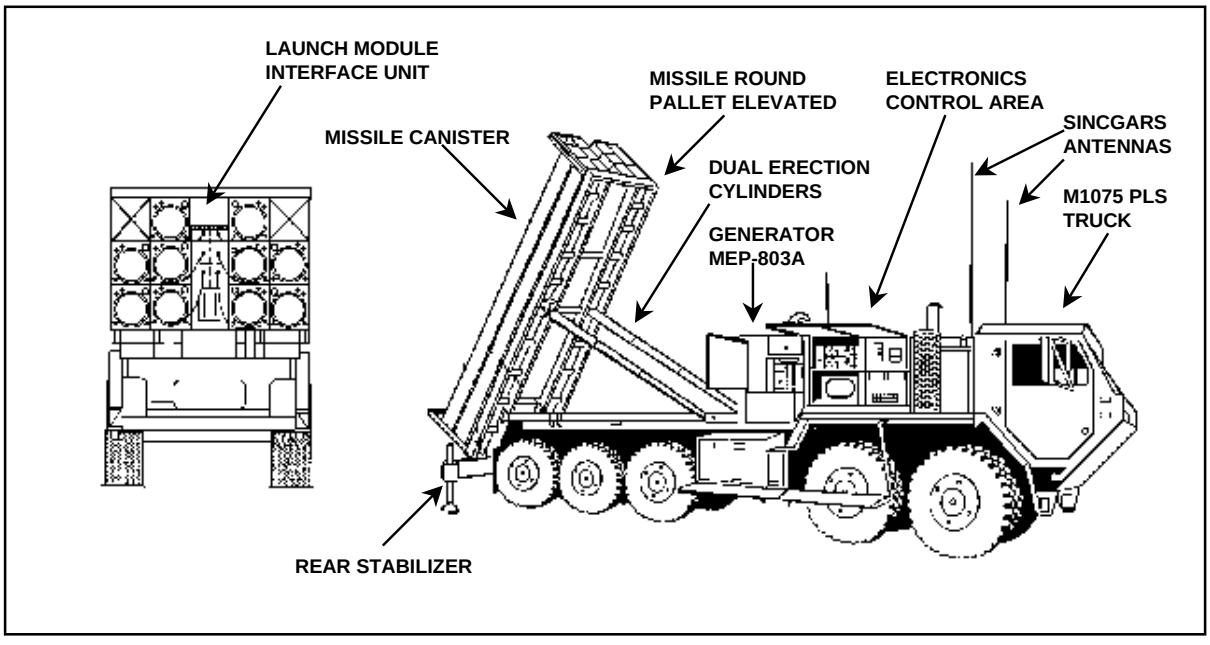


Figure 4-7. THAAD Launcher

4-22. The launcher can carry eight missile rounds to a designated site and be available to launch within 30 minutes of arrival. Reload can also be accomplished within 30 minutes. All rounds may be fired in rapid sequence or individually. Launcher emplacement can be done on inclines of up to ten degrees. The launcher can be transported on any Navy cargo ship, flatbed

railroad car, or Air Force C141 and larger cargo aircraft. Once emplaced, the battery TOC controls the launchers through a fiber optics link to a LCS.

4-23. **Modified PLS Truck**. The PLS truck was modified by removing or relocating some PLS standard equipment, adding rear outriggers, stabilizers, work platforms, a hydraulic erection system, and a class VI safe for classified material storage. THAAD equipment installations include an electronics module, 10 kw generator, wiring harness, electrical motor-driven hydraulic back-up pump, and a ground rod driver. Two SINCGARS radios are installed in the cab for voice communications.

4-24. **Missile Round Pallet**. The missile round pallet is equipped with dual hydraulic cylinders for elevation purposes. The missile round pallet is used to support and erect a minimum of eight missiles to the launch elevation angle. The MRP incorporates an Azimuth Determination Unit (ADU) that provides azimuth alignment information for the launcher during combat operations and a missile umbilical junction box that provides truck-to-MRP electrical interface. The missile round pallet has forklift pockets for ground handling.

4-25. **Electronics Module**. The electronics elements are incorporated into the launcher electronics module on the curbside between the cab and the missile round pallet. The elements include the launch control unit, a precision lightweight global positioning system receiver, power distribution unit, and a rechargeable battery. The 10 kw generator recharges the battery and is mounted on the roadside between the missile round pallet and the engine on sliding rails to provide maintenance access.

Missile Round

4-26. The THAAD missile round consists of a missile assembly and its canister. Eight missile rounds are mounted on the missile round pallet. The missile rounds remain on the pallet through shipment, storage, handling and loading on the launcher until the missile is fired. Indicators and electrical connections are located at the aft end of the canister. The indicators allow the operators to monitor status of the missile round. The electrical connectors are used to connect the missile to the launcher via the launch module interface unit.

4-27. **Canister**. The missile canister weighs 816 pounds, is 261 inches long and 18.1 inches wide. It provides the means to store, transport, and launch the missile. It also provides an environment for missile transportation and can maintain the missile in a ready condition for up to ten years. The canister is designed to allow access to the missile electronically through an umbilical cable connection. The canister is made of a filament wound graphite composite shell.

4-28. Guide pins located at the ends of the canister enable stacking and assembly on to the missile round pallet. Muzzle and breech closures provide a seal that protects the interior of the canister from dust, sand, and moisture. The seals will rupture upon launch and are designed not to cause interference with the launch or adjacent missile launches from the same MRP.

4-29. **Missile Assembly**. The missile assembly (figure 4-8) consists of a single-stage solid propellant rocket booster and a homing kill vehicle (KV). An Interstage assembly provides a structure for mounting the KV to the booster. Descriptions of the missile assembly components follows:

- Booster section. (Composed of the propulsion section, thrust vector control (TVC), and the flare assembly). The booster section contains the propulsion system that provides the initial thrust to get the kill vehicle to the proper altitude and attitude for interception.
- Interstage assembly. Subcomponents are the electronics assembly, separation motor, and the flight termination system. The interstage assembly is the transition region between the propulsion section and the kill vehicle.
- Kill vehicle. The kill vehicle (KV) is designed to destroy its target with kinetic energy and does not include a warhead. It is designed with an infrared (IR) homing seeker that detects and homes on the target to destroy it by body-to-body contact with the KV steel nosetip.

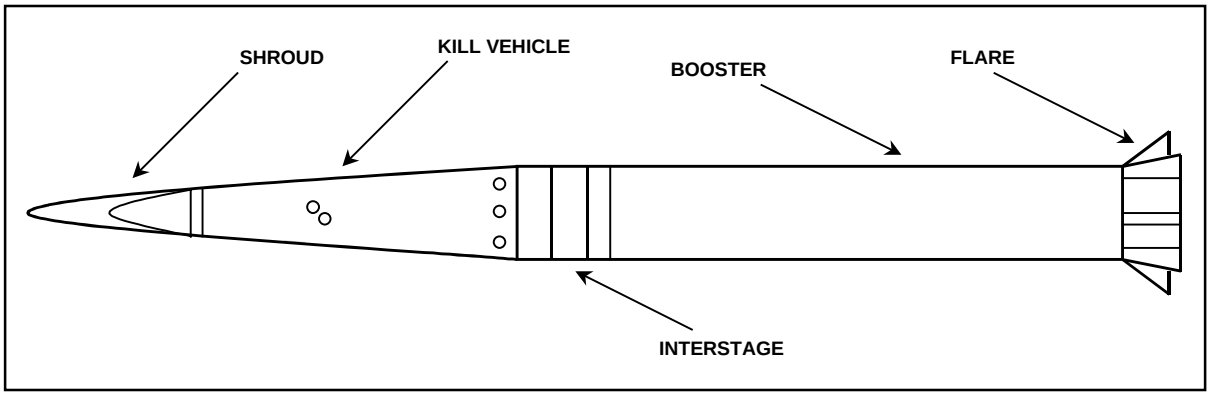


Figure 4-8. THAAD Missile

SYSTEM OPERATIONAL OVERVIEW

4-30. The BM/C3I equipment manages THAAD system operations. The BM/C3I communicates with the radar and the launchers, via radios or fiber optic cables, to gather status data and issue commands. A TSG performs force operations in support of engagement operations as a communications relay or in support of remote launchers and radar. The following paragraphs explain an engagement in functional terms of surveillance, threat evaluation, weapon assignment, engagement control, and missile operations. Figure 4-9, page 4-11, illustrates a THAAD engagement sequence.

Surveillance

4-31. The EO/FO TSG will provide sensor search parameters, threat prioritization, and saturation alleviation rules during initialization. The radar responds to the BM/C3I commands by executing the designated mission profiles. During execution the radar detects tracks, classifies, identifies, discriminates, and types the threat. The radar also determines estimated launch and impact points. The radar passes this information to the

EO TSG for threat evaluation, weapon assignment, and dissemination to external systems and higher echelons. The EO TSG directs radar operations and performance in order to monitor threat priority, avoid saturation, and implement required emission control (EMCON).

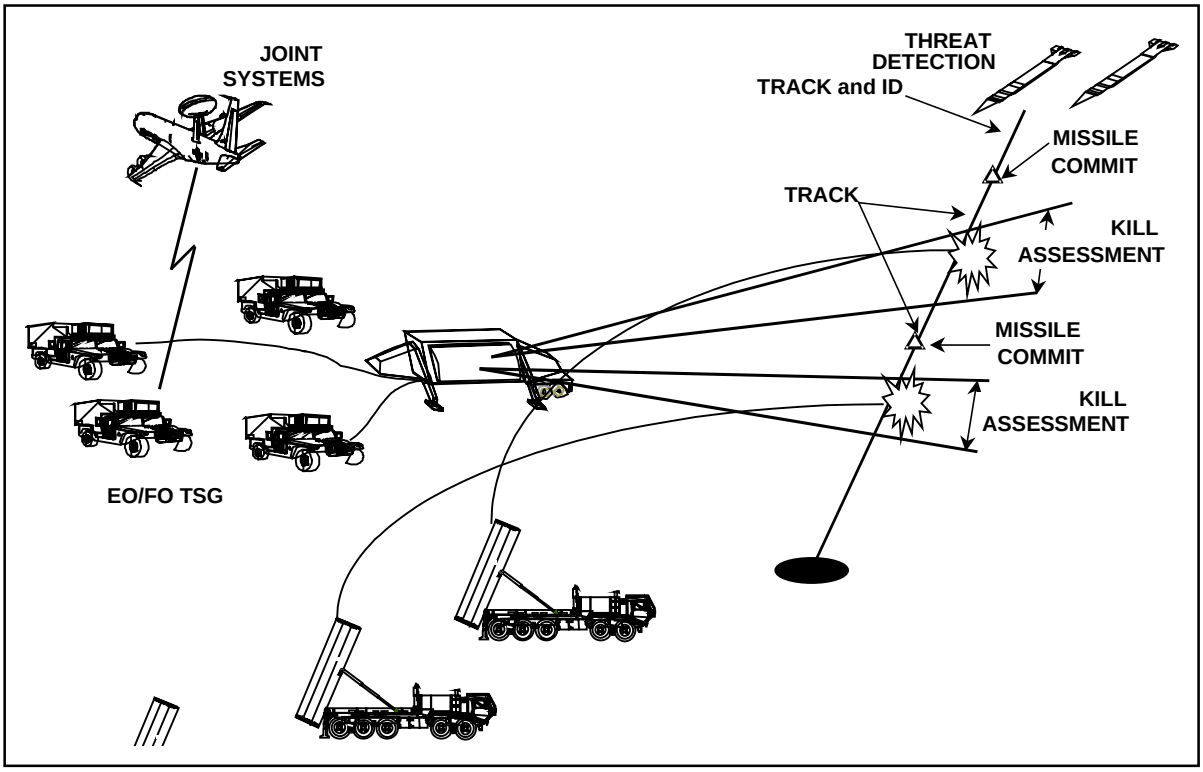


Figure 4-9. THAAD Engagement Sequence

Threat Evaluation

4-32. Threat evaluation involves determining which enemy TBMs pose a threat to the defended area and prioritized assets. It also determines which assets are threatened and the number of TBMs attacking each threatened asset. The system conducts threat evaluation on those TBMs whose track maturity is sufficient to allow for the conduct of meaningful threat-asset pairing.

Weapon Assignment

4-33. Weapon assignment involves the selection and scheduling of available launchers and missiles against attacking TBMs. It is an iterative process that is repeated at fixed intervals or upon the occurrence of an event that alters the weapon assignment basis. The system first determines available battlespace, first shot, last shot, best shot opportunity, and the available engagement opportunities. Based on the number of engagement opportunities available and the number of missiles allocated according to

defense objectives, the system selects a method of fire. The system uses shoot-look-shoot as the method of fire where feasible.

4-34. The system examines launcher-target combinations with a view toward selecting intercept points that maximize system effectiveness and scheduling intercepts so that the radar is not overloaded and scheduling launchers that can best support the engagement. The system plans subsequent shot opportunities for execution, if required. Based on the above, the system selects for implementation the set of launcher-target schedules most nearly satisfying the decision criteria. Launch time is predicated on achieving an intercept point location accuracy that is good enough to ensure that the missile possesses sufficient divert capacity and that the target will be in the missile seeker's acquisition field of view.

Engagement Control

4-35. Engagement control involves determining the fire control solution and those BM/C3I and radar functions associated with controlling the engagement through kills assessment and possible re-engagement. After missile commit and prior to launch, the system determines the final trajectory, monitors launch and launch time, establishes the guidance and track update schedule, and schedules radar and communications support resources. During missile flyout, the EO TSG determines guidance and target information and transmits them to the missile through the radar. The radar tracks the missile and target through intercept and provides kill assessment data to the EO TSG. In case of a miss, re-engagement is immediate, battlespace permitting. In case of a miss with an uncertain kill, the system re-identifies the target and reinitiates the threat evaluation and weapon assignment processes and is reengaged if battlespace permits.

Missile Operations

4-36. The following paragraphs summarizes the major actions from the time the EO TSG determines engagement solutions up to destruction of a target by the kill vehicle (KV) with kinetic energy.

4-37. **Prelaunch**. The EO TSG determines the engagement solution and pairs the target with the launcher. It schedules the launch. It also provides trajectory parameters to the radar and launcher, which update the radar, and initializes the missile via the launcher. The missile performs built-in-tests in response to the EO TSG command and relays results back to the EO TSG via the launcher.

4-38. **Launch**. The EO TSG sends the fire command to the missile via the launcher. The missile booster ignites. The launcher then provides the EO TSG the exact time of launch.

4-39. **Boost**. The booster section contains the propulsion system that provides the initial thrust to get the kill vehicle to the proper altitude and attitude for interception. The booster section has two sub-components: the propulsion section and the thrust vector control (TVC). The EO TSG updates actual time of launch and sends it to the radar. The radar provides boost phase update to the in-flight missile. The missile then deploys the booster flares.

4-40. **Postboost**. The EO TSG provides in-flight target and missile status update to the missile via the radar. The booster then separates. The radar provides the EO TSG with the kill vehicle (KV**)** and target status.

4-41. **Midcourse**. The EO TSG provides in-flight target update to the KV via the radar. A divert and attitude control system (DACS) provides the KV with angle of attack and roll control. The KV has a self**-**contained cooling system that cools the seeker when in the IR operation. Seeker cool down begins prior to acquisition.

4-42. **Hand-over and Acquisition**. The EO TSG provides final in-flight target update and target object map (TOM) to the KV via the radar. The TOM is designed to display object details and includes range, altitude, speed, and threat class. The shroud separates from the KV. The seeker begins acquisition mode. The KV matches the seeker scene against the TOM. The KV designates the target and initiates a track file.

4-43. **Target Track**. The KV downlinks processed homing data. The KV steers to aimpoint based on radar estimates and the thrusters' control of the KV attitude.

4-44. **Engage**. The KV resolves the target image and determines the final aimpoint. The KV diverts to intercept and downlinks homing data.

4-45. **Impact and Target Destruction**. The KV hits the target with tremendous kinetic energy to destroy the TBM. The radar updates the EO TSG data and then conducts kill assessment.

Communications Equipment

4-46. Many different types of communications equipment is organic to the THAAD battery. Each has different characteristics and multiple potential uses. These items consist of radio terminal sets, telephone sets, and communications processors. Together they makeup the heart of the THAAD communications system and are described in the following paragraphs.

4-47. **AN/GRC-193A Radio**. The AN/GRC-193A is a long-haul EO HEU secondary radio communication network which supports the air defense coordination net (ADCN).

4-48. **AN/GRC-226 Radio**. The AN/GRC-226 UHF (band 3 only), 15 channel radio operates in the 225 – 400 MHz band. This radio is compatible with radios used in the ACUS network. Two AN/GRC-226 radios are installed in each LCS. The radio provides line-of-sight communications for both voice and data. This is a bulk (trunk) encrypted communications link containing multiplexed voice and data circuits. Each set is comprised of a receiver-transmitter, a baseband assembly, and an antenna assembly.

4-49. **AN/GSQ-240 JTIDS Class 2M Radio**. The JTIDS provides a jam resistant ground-to-air and ground-to-ground data communications. JTIDS is a high-speed data radio that operates in a time-shared data network providing access to theater EO surveillance and targeting information network via a time division multiple access (TDMA) architecture in the 960 MHz to 1215 MHz frequency range. Within the battery, JTIDS supports the EO data communications between the EO TSG and the SSI. The JTIDS

terminal, with omnidirectional antenna and telescoping mast makes up JTIDS. The JTIDS may be initialized through any one of the TOS or LCS workstations.

4-50. **Commander's Tactical Terminal**. The CTT is a hybrid two-channel receiver that operates within the 225 MHz to 1.4 GHz UHF frequency range. It provides access to a TIBS intelligence network via either LOS or satellite broadcasts. This terminal is interfaced to a laptop computer that provides THAAD access to intelligence information at theater and national levels. The CTT utilizes the LCS roof mounted dual batwing antenna.

4-51. **Compact Digital Switch**. The Compact Digital Switch (CDS [ON-422]) is the heart of the THAAD's communication capabilities. It can handle over 708 individual circuits (THAAD requires less than its capability). This device routes telephone and data throughout the battery and the external ACUS network. Each LCS contains one CDS, which includes a multi-station intercom system with selective answering capability, audible/visual alerts, and conference calling (intercom, radio, and telephone) capability. The two associated pieces of COMSEC equipment are the speech security equipment and the trunk encryption devices that provide bulk encryption for ACUS purposes. The software used to initialize the CDS is contained in a laptop computer. The software version of the CDS must also be compatible with the software version used by the MSE system. Pre-affiliation lists (routing tables) and individual phone lists must also stay current to ensure maximum interoperability.

4-52. **Encryption Devices**. THAAD has two types of encryption for the ACUS/MSE network. The first is a trunk encryption device (TED), KG-194A. This device performs trunk encryption (e.g. encrypts all the channels in the trunk group) for external connectivity. There are two TEDs per LCS that support the AN/GRC-226 radio and the CDS. They also support the two trunk cable connections (TG1 and TG2) located at the communication demarcation panel. The second device is a KIV-7 that is also routed through the CDS. The KIV-7 supports single channel TADIL B data link encryption. This data link is used to exchange EO data with an Air Force CRC or a Marine TAOC.

4-53. **Fiber Optic Cable**. Fiber optic communications consist of modulator-demodulator equipment connected by cables with four fiber optic strands tied together to form cables capable of carrying data and voice. These cables are in one-kilometer increments. For the fiber optic cables a maximum distance of two kilometers may be used. The BMC3I, radar, LCS, and launcher sections all use the same cable type. At the BMC3I, radar and LCSs, the fiber optic cables are used to interconnect the TOS and LCS in any configuration. These local area network (LAN) configurations are referred to as the fiber optic data distribution interface (FDDI) system.

4-54. **Global Positioning System**. Each major subsystem with the THAAD battery has a GPS. The GPS is used for location identification and time synchronization across the battery. The GPS (PLGR) unit may also be removed from the mounted location and used as a handheld receiver for navigational purposes. However, prior to removing the GPS receiver from the mounted location, the GPS must be inactivated from the THAAD tactical software to avoid system faults.

4-55. **Mobile Subscriber Equipment**. THAAD includes communications equipment that supports an interface into the Army's MSE area common user system (ACUS) network. This equipment functions as a MSE small extension node (SEN); however, unlike other ADA systems this functionality is integrated into the LCS design. Current LCS equipment associated with MSE are: two each AN/GRC-226 radios, encryption devices, compact digital switch (CDS), and the availability to have THAAD non-organic MSE and ACUS communications system connectivity.

4-56. **SINCGARS Radios**. SINCGARS is a VHF single channel, push-to-talk radio which operates either in single frequency or frequency hopping modes at 30 to 88 MHz. The THAAD battery uses several models of SINCGARS. In UOES only, all primary convoy vehicles contain an AN/VRC-87A SINCGARS. The LCS, launcher, and launcher prime mover contain the AN/VRC-90. The LCS radio voice interface is connected to the radio connector panel to provide access for voice circuits. These radios provide the secondary voice communication and support voice on the move for other THAAD elements. Within the battery there are additional SINCGARS radios which are used to support the functions of command, logistics, administration, intelligence, and operations. All SINCGARS contain internal COMSEC capability, mounted (AS-3900) and dismounted antennas (OE-254).

4-57. **THAAD Non-Organic MSR and ACUS Connectivity**. At the communication demarcation panel, there are two (2) types of signal connectors. There are three (3) CX-11230 digital trunk group connectors. These connectors allow THAAD to have curbside signal support. The next types of connectors are binding posts used to extend and connect DNVTs, DSVTs, or individual data circuits to a local subscriber. The wire may be WD-1 or WF-16.

4-58. **Wire**. Wire communications consist of wires connected to field telephones, terminal boxes and switchboards. The wire is either WD-1 or WF-16, which as previously stated, is used to extend the subscriber terminals to the required location.

Internal Communications Networks

4-59. **Battery Mission Operations Network**. The battery mission operations network provides FO and EO command and control. The internal battery network connects force operations and engagement operations TSGs, the radar, and launchers in a variety of configurations using radio and FOC. The EO/FO TSGs are connected to the radar and launchers using fiber optic cable when collocated, or radio to a remote launcher or radar with the use of a CR or SSI, respectively. The FOC system interconnects with the THAAD voice communication subsystem station in the TOS. The battery TOC includes two TOS shelters, one for FO and one for EO, and two LCS shelters that functionally support force operations and engagement operations. Internal communications for each section supports force and engagement operations when emplaced (figure 4-10, page 4-16).

4-60. **Battery Wire/Telephone Network**. The battery wire network is the primary means of voice communications among the battery elements

(figure 4-11). It provides access to external telephone networks all primary battery elements.

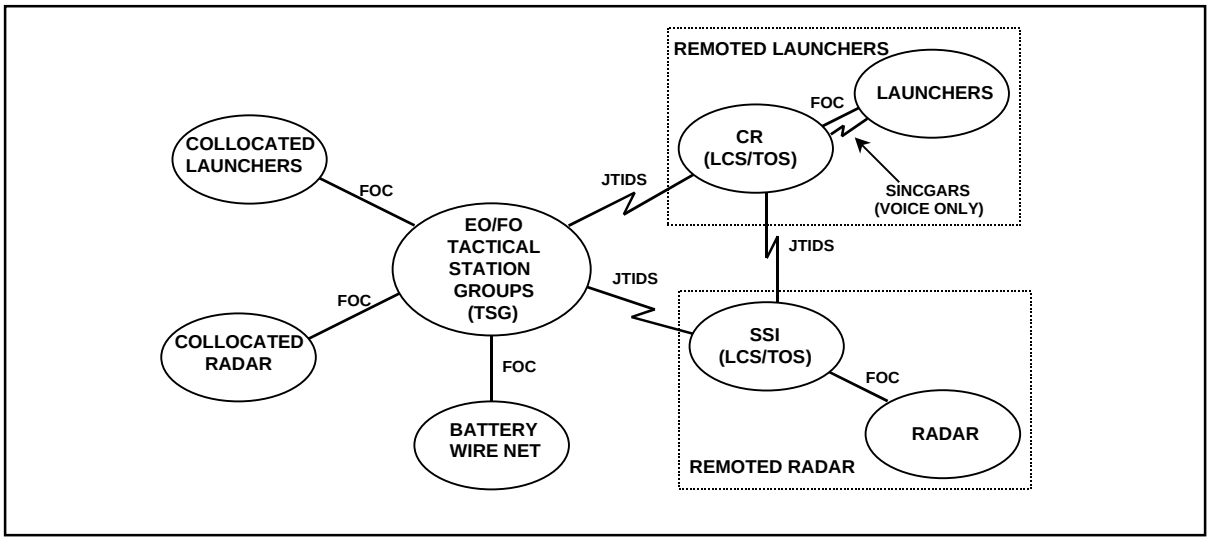


Figure 4-10. Battery Mission Operations Net

4-61. **Battery FM Command Net**. The battery FM command net uses the SINCGARS radios and is primarily used during battery movement, march order and emplacement, RSOP, and when fiber optic or wire communications is not available. The battery command net is a back up to the mission operations network once emplaced and can provide for command and control for the battery when wire and cable communications are not available. The NCS is normally the battery CP (figure 4-12, page 4-17).

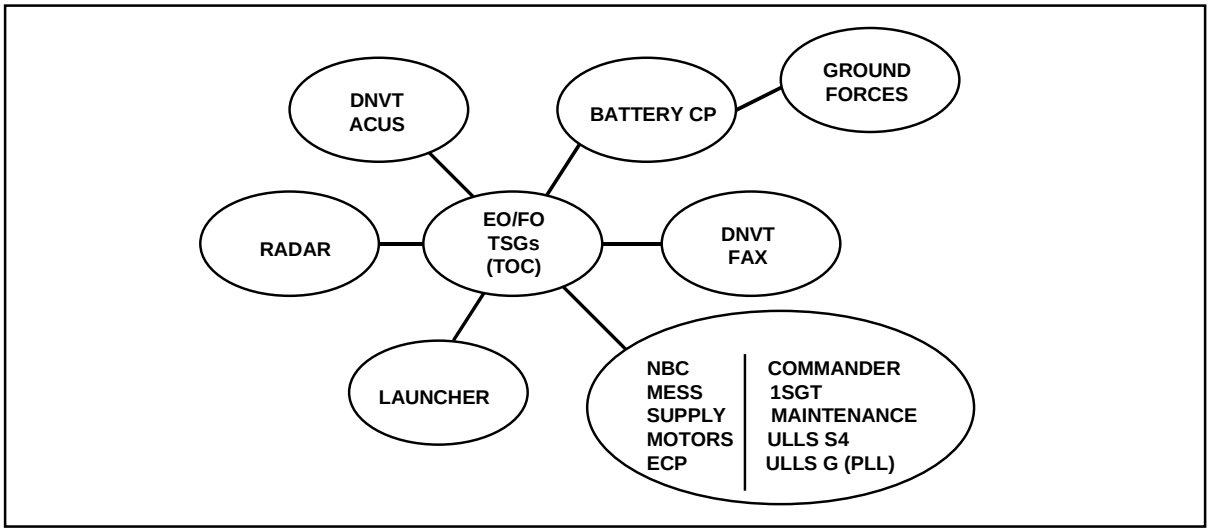


Figure 4-11. Battery Wire/Telephone Net

4-62. **Battery FM Support Net**. The battery FM support net uses the SINCGARS radios. It is primarily utilized during command post emplacement or when there is

insufficient fiber optic or wire communications. This radio net is utilized to control mobile maintenance support activities through the TMC for conventional maintenance and contractor logistics support for system maintenance (figure 4-13, page 4-18).

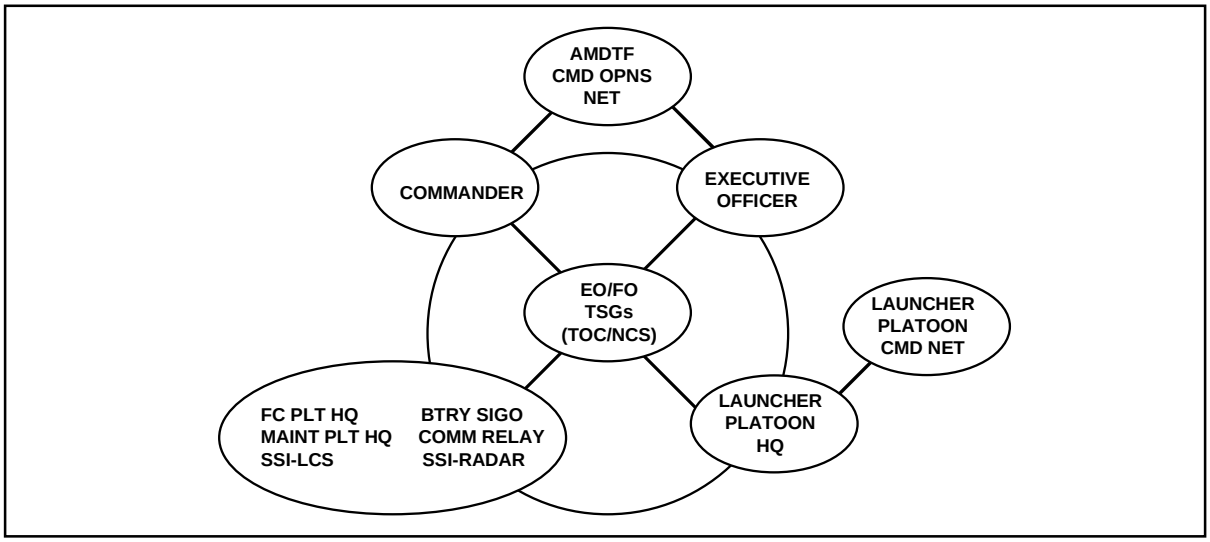


Figure 4-12. Battery Command Net (FM Radio)

4-63. **Launcher Platoon FM Command Net**. The launcher platoon FM command net uses the SINCGARS radios. It is utilized during periods of movement, march order and emplacement, and static operations of site defense coordination (figure 4-14, page 4-18).

External Communications Networks

4-64. THAAD units will exchange or receive operations, intelligence, coordination, support, and planning data with units that are external to the AMDTF. The external networks used are the area common user system, TIBS intelligence, and joint data networks.

4-65. **Area Common User Network**. Doctrinally, Theater Army, EAC, and corps signal brigade resources provide MSE and Tri-tactical (Tri-Tac) communications support as required by the theater commander. This support consists of voice and data over MSE packet networks, and Tri-Tac network services. These communications resources collectively make up the Tri-Tac communication systems at the EAC level, and the ACUS at corps level and below, to include the division levels. The ACUS and or Tri-Tac networks may provide secure EO voice and secure FO voice and fax data connectivity to the THAAD battery depending on the battery's location.

4-66. **Tactical Intelligence Broadcast Service**. The TIBS network provides time-sensitive tactical information to THAAD via UHF broadcast from aircraft and/or the satellite communications system. TIBS provides tactical data and alert and early warning of TBM launches. Data can be filtered based on THAAD specified parameters such as areas of interest, altitudes, specific targets, collection parameters, etc. Up to 20 filters can be

selected through software and initiated by the laptop computer workstation. Primary interest in TIBS data is TBM launch.

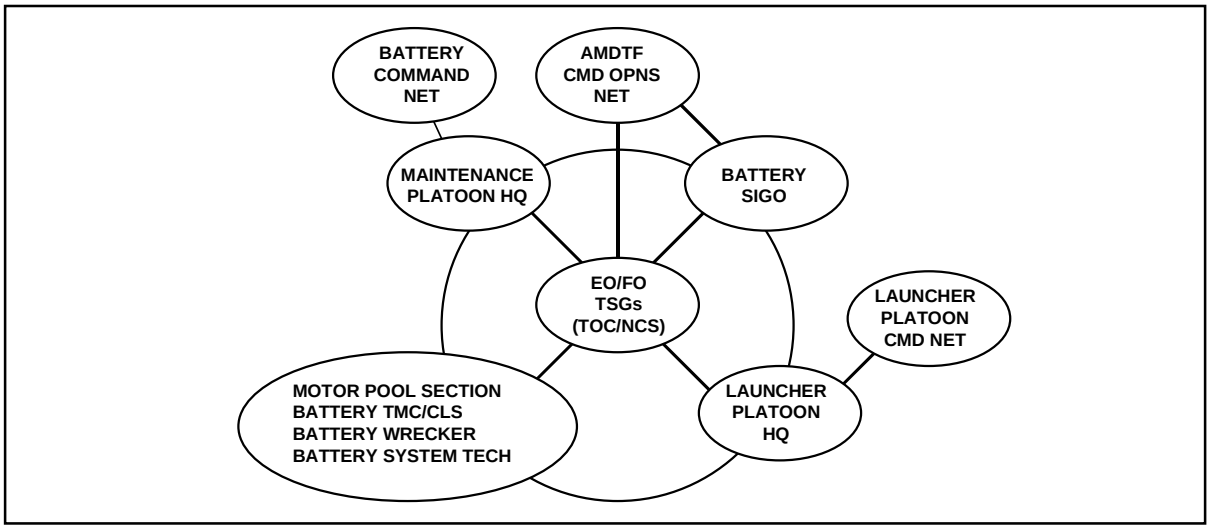


Figure 4-13. Battery Support Net (FM Radio)

4-67. The commander's tactical terminal (CTT) is interfaced to a separate laptop computer in the LCS. This gives THAAD the capability to receive and display (on the laptop) TIBS data. The TIBS data is not integrated into the tactical software. If possible, the unit may acquire the means to remote the laptop to the EO TOS with the use of an extension cable. If not, the LCS operator must monitor both the CDS and CTT laptops and inform the EO/FO TOS operators of pertinent TIBS data via telephonic means. THAAD can use the TIBS data for planning purposes and telephonic warning.

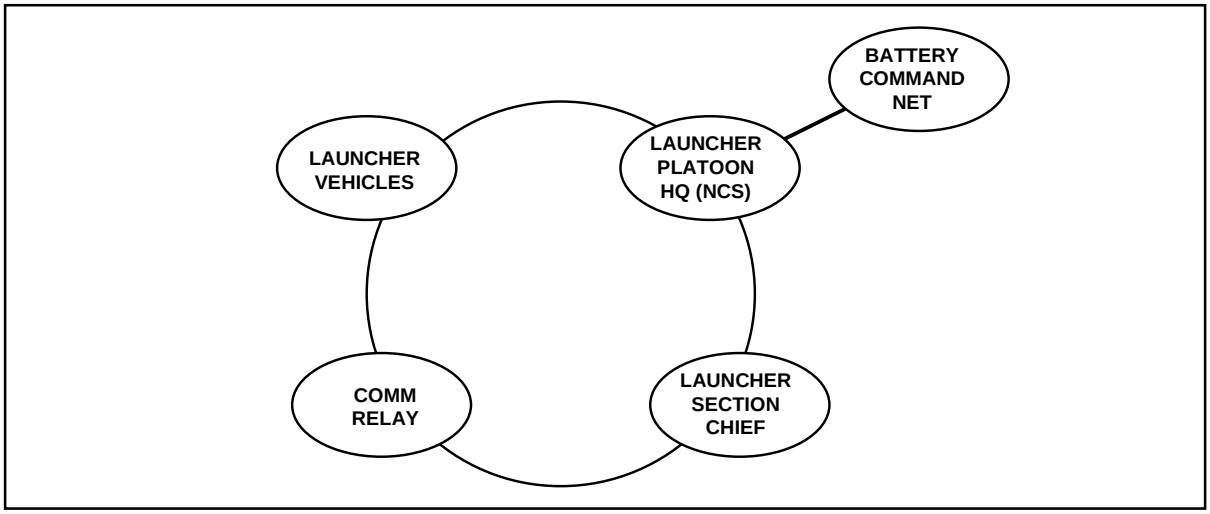


Figure 4-14. Launcher Platoon Command Net (FM Radio)

Chapter 5

Patriot Air Defense System

This chapter describes Patriot air defense system. This system is deployed to defend theater and corps commanders' assets.

MISSION

5-1. The mission of Patriot is to provide protection for critical assets and maneuver forces belonging to corps and echelons above corps (EAC) against airborne threats from very low to very high altitudes. The objective of Patriot operations at all levels is to disrupt and destroy the enemy's ability to mount effective air operations.

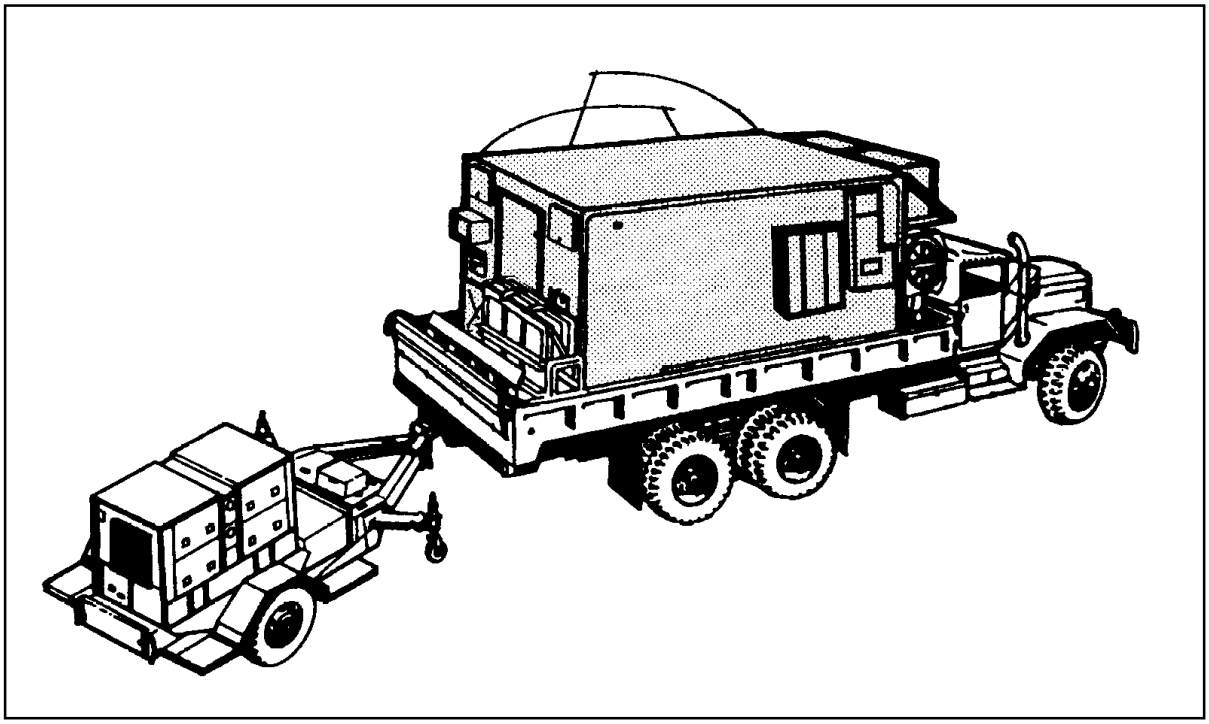


Figure 5-1. Information and Coordination Central

SYSTEM DESCRIPTION – BATTALION FIRE DIRECTION CENTER

5-2. The major end items of the Patriot battalion fire direction center (FDC) are the Information and Coordination Central (ICC) (AN/MSQ-ll6), Electric Power Unit (EPU II) (PU 789), Communications Relay Group (CRG) (AN/MRC-137) and Antenna Mast Group (AMG) (OE-349/MRC).

INFORMATION AND COORDINATION CENTRAL

5-3. The ICC is the C3 center of the Patriot battalion during AD operations. The ICC consists of a lightweight weather tight shelter mounted on a 5-ton cargo truck (figure 5-1, page 5-1). The shelter provides shielding from radio frequency interference (RFI) and electromagnetic pulse (EMP) radiation. It is equipped with two externally mounted air conditioners that cool, heat, and ventilate the interior. An externally mounted gas particulate filter unit (GPFU) is used in NBC situations to provide clean air for crewmembers.

5-4. The ICC contains two consoles that are manned by the tactical director (TD) and tactical director assistant (TDA). Between the two consoles is an ICC status panel that displays the status of all battalion fire units (FU).

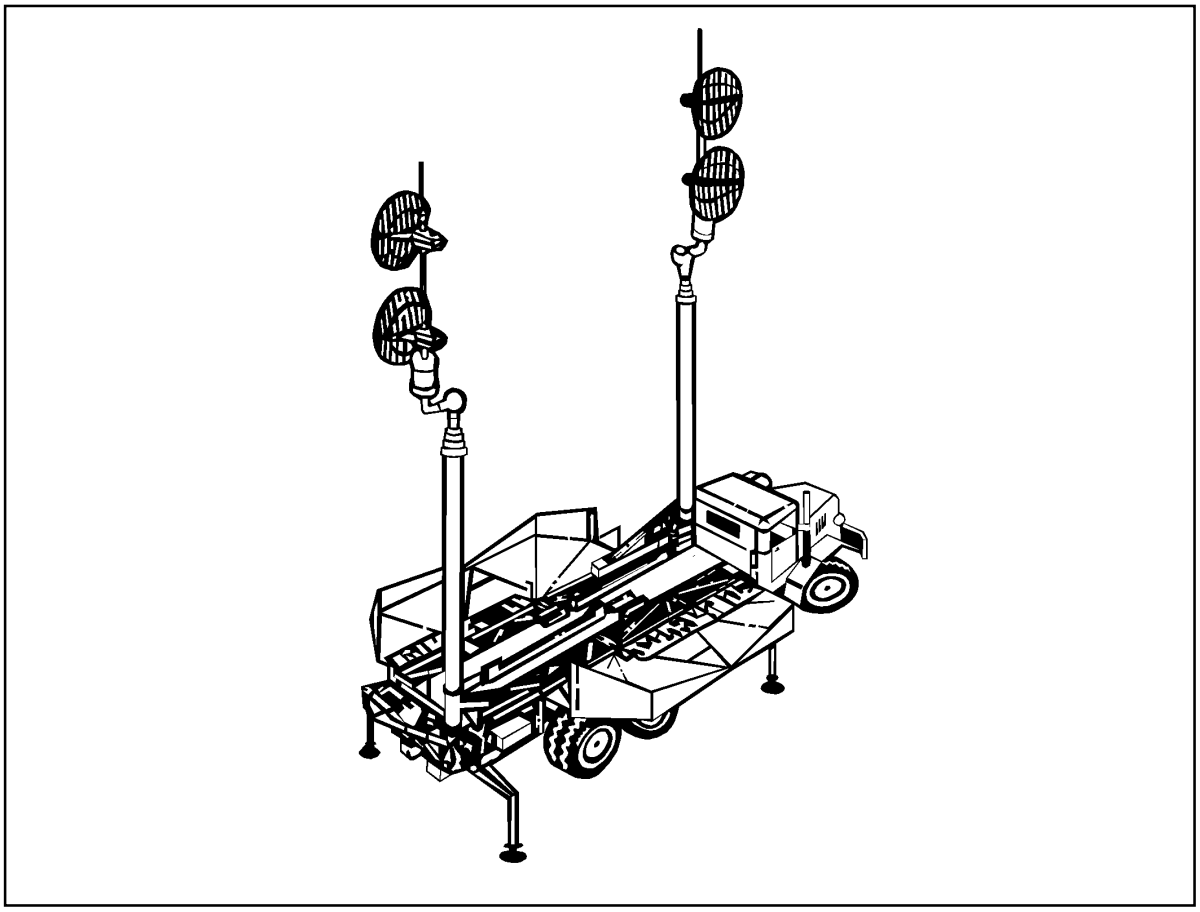


Figure 5-2. Antenna Mast Group Emplaced

ELECTRIC POWER UNIT

5-5. The EPU II is the prime power source for the ICC and CRG. The EPU II consists of a 30 kw, 400 Hz generator mounted on a trailer and towed by the ICC or CRG. Two generators will be used for the ICC and two generators for the CRG.

COMMUNICATIONS RELAY GROUP

5-6. The CRG provides a multirouted secure, two-way data relay capability between the ICC, its assigned fire units, and between adjacent units. The CRG also provides the capability for both data and voice exit and entry communication points with elements that are external to Patriot.

ANTENNA MAST GROUP, TRUCK MOUNTED, OE-349/MRC

5-7. The AMG (figure 5-2, page 5-2) is a mobile antenna mast system used to carry the amplifiers and antennas associated with the UHF communications equipment located in the ECS, ICC, and CRG. Four antennas are mounted in two pairs, are remotely controlled in azimuth, and can be elevated to heights up to 100 feet, 11 inches, above ground level.

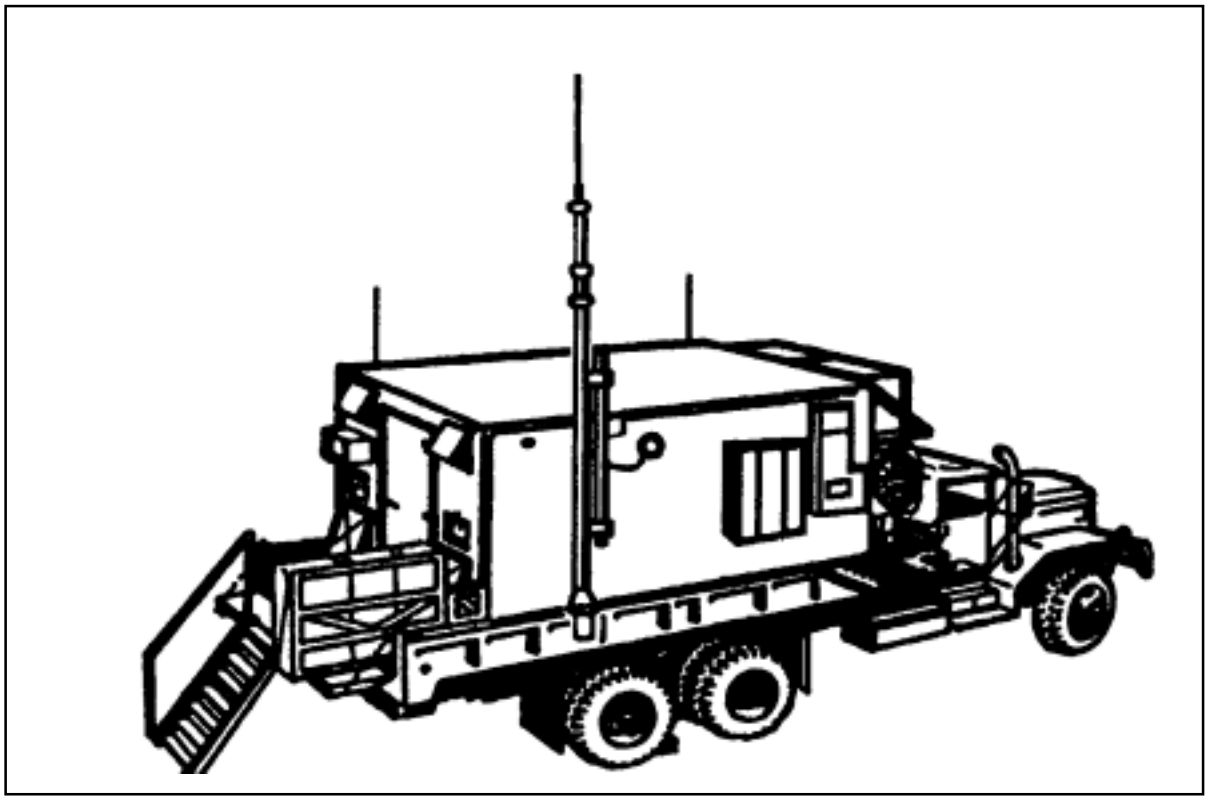


Figure 5-3. Engagement Control Station Emplaced

SYSTEM DESCRIPTION - FIRING BATTERY

5-8. The heart of the Patriot battery is the fire control section and associated launchers. The major end items are the Engagement Control Station (ECS) (AN/MSQ-104), Electric Power Plant (EPP III) (M977EPP), Radar Station (RS) (AN/MPQ-53), eight Launching Stations (LS) (M901) and Antenna Mast

Group (AMG) (OE-349/MRC). A general description of end items including the purpose and characteristics follows.

ENGAGEMENT CONTROL STATION TRUCK MOUNTED AN/MSQ-104

5-9. The ECS is the operational control center of the Patriot FU (figure 5-3, page 5-3). It contains the WCC, man/machine interface and various data and communications terminals. The ECS is air-conditioned and includes protection devices for use in NBC and EMP environments.

5-10. The ECS shelter provides shielding from RFI and is a weather-tight enclosure with appropriate air inlet and exhaust ports for the environmental control systems. The left side as seen from the doorway includes three UHF RRT and a voice communications station. The right side includes the very high frequency (VHF) DLT, radar weapon control interface unit (RWCIU), WCC, an AN/VRC-92A SINCGARS radio, optical disc drives (ODD) and embedded data recorder.

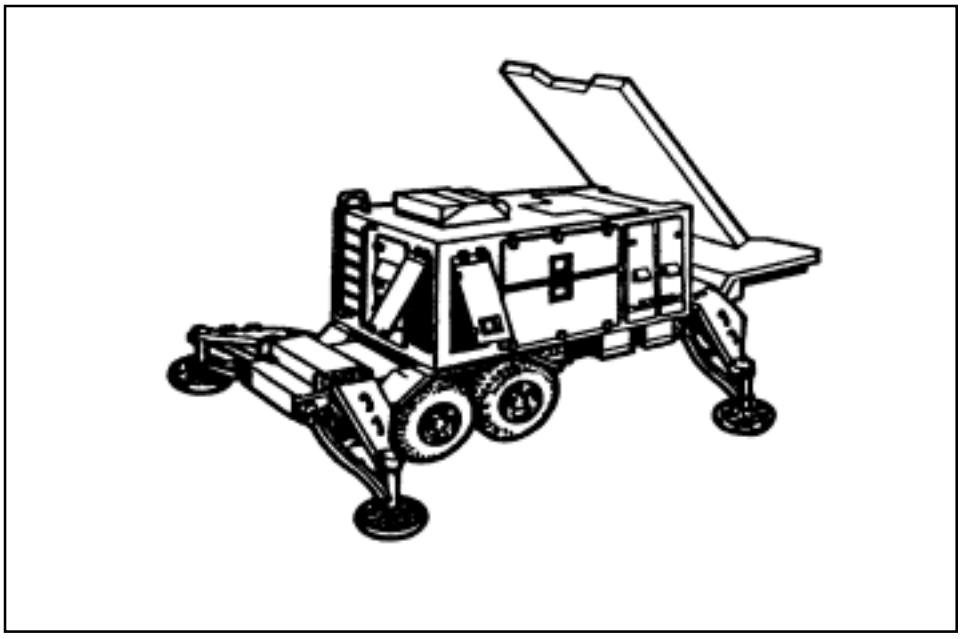


Figure 5-4. Patriot Radar Set

RADAR SET, SEMI-TRAILER MOUNTED, AN/MPQ-53

5-11. The RS consists of a multifunction phased array radar mounted on an M-860 semi-trailer towed by an M983, heavy expanded mobility tactical truck (HEMTT) (figure 5-4). It is monitored and controlled by the ECS via the radar and weapon control interface unit. It performs very low- to very high-altitude

surveillance, target detection, target classification, target identification, target track, missile track, missile guidance, and ECCM functions.

5-12. The radar antenna is positioned at the forward end of the shelter and is erected to a fixed 67.5° angle relative to the horizontal plane during emplacement. Integral leveling equipment on the M-860 semi-trailer permits emplacement on slopes of up to 10°.

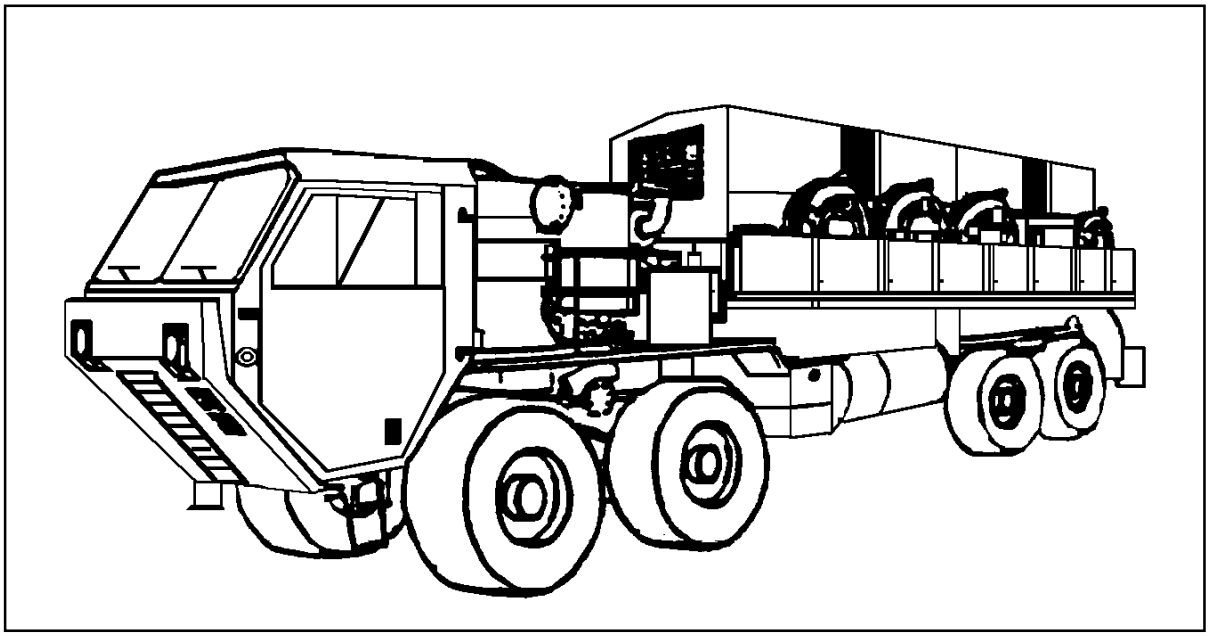


Figure 5-5. Electric Power Plant III

ELECTRIC POWER PLANT

5-13. The Electric Power Plant (EPP III) (figure 5-5) is the prime power source for the ECS and RS. Each EPP consists of two 150 kw, 400 Hz diesel engines that are interconnected through the power distribution unit (PDU) and are mounted on a 10-ton M977 HEMTT. Each EPP contains two interconnected 75-gallon fuel tanks and a fuel distribution assembly with grounding equipment. Each diesel engine can operate more than eight hours with a full fuel tank.

ANTENNA MAST GROUP, TRUCK MOUNTED, OE-349/MRC

5-14. The AMG (figure 5-2, page 5-2) is a mobile antenna mast system used to carry the amplifiers and antennas associated with the UHF communications equipment located in the ECS, ICC, and CRG. Four antennas are mounted in two pairs, are remotely controlled in azimuth, and can be elevated to heights up to 100 feet, 11 inches, above ground level.

5-15. Emplacement consists of stabilizing the AMG, setting the antenna feed and the erection of the antennas by the use of self-contained hydraulic and pneumatic systems and then adjusting the antenna elevation. Connecting cables to the collocated shelter is carried on the AMG and includes RF cables, control cables, and a prime power cable.

LAUNCHING STATION, GUIDED MISSILE SEMI-TRAILER MOUNTED

5-16. The Launching Station (LS) (figure 5-6) is a remotely operated, fully self-contained unit, that has integral onboard power and carries up to four guided missiles (PAC-2), or 16 missiles (PAC-3). Operation is controlled in the ECS via fiber optics or VHF data link. The LS is mounted on an M-860 semi-trailer towed by an M983 HEMTT. Leveling equipment permits LS emplacement on slopes of up to 10°. The LS is trainable in azimuth ±110° and elevates to a fixed, elevated, launch position. The LS has to be precisely emplaced and aligned prior to launch. Proper emplacement and alignment is critical for engagement of ballistic missiles.

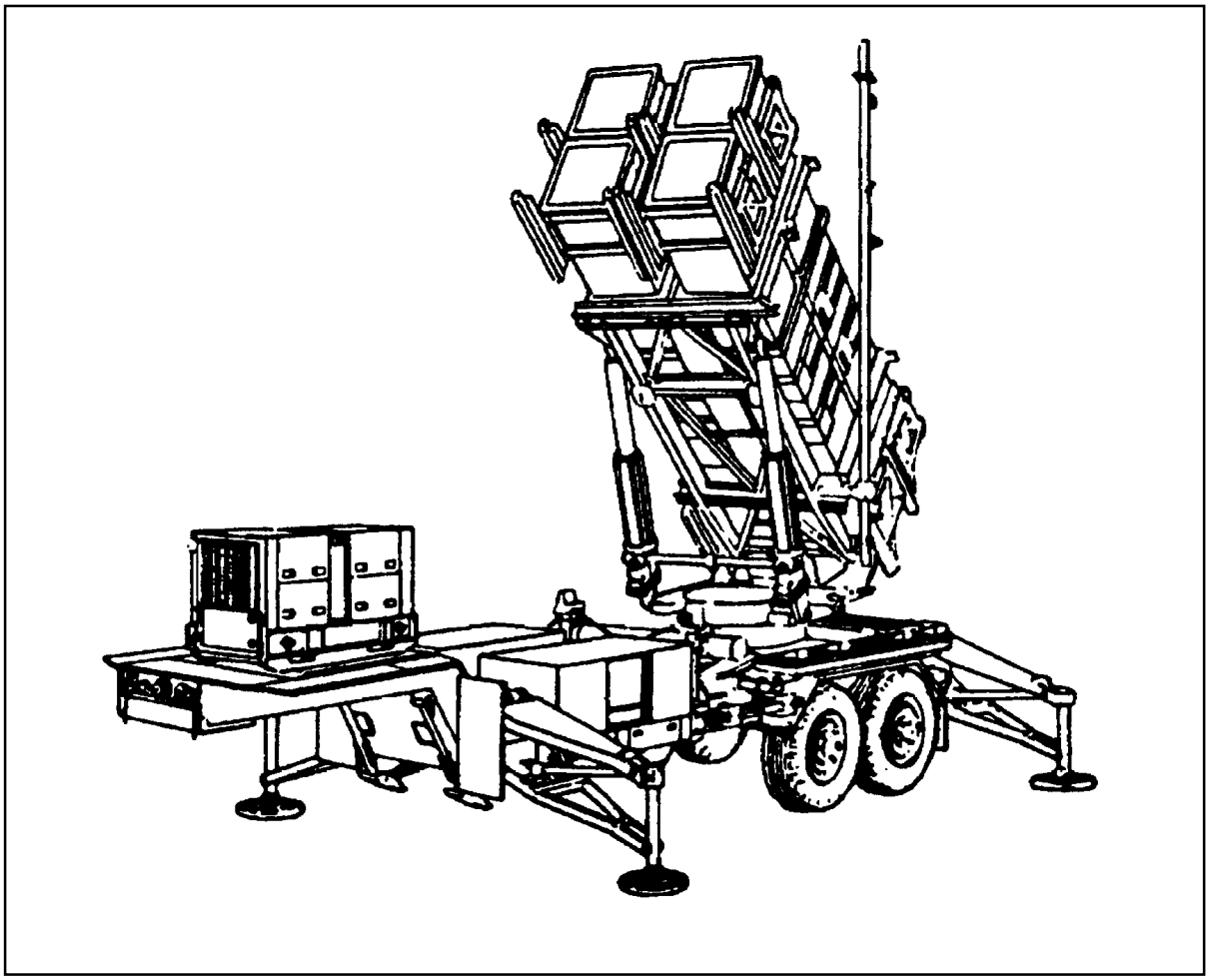


Figure 5-6. Launching Station Emplaced (PAC-2)

5-17. The Launching Station contains four major equipment subsystems. The four subsystems are as follows:

- Launcher generator set: the onboard source of LS electrical power.
- Launcher Electronics Assembly: two trailer-mounted equipment consoles that receive, decode, and execute commands of the ECS.

- Launcher Mechanics Assembly: elevates the guided missiles and contains a data link antenna mast for communications with the ECS.
- Launcher Interconnection Group: interconnects onboard LS equipment and controls the routing of electrical function lines to and from the guided missiles.

5-18. The Generator for the LS is located on the yoke assembly of the trailer and includes a built-in 56.8-liter (15-gallon) fuel tank. It has side-mounted work platforms. The unit is a diesel engine-driven generator, 15 kw, four-wire, 400-hertz, 120/208-volt power.

GUIDED MISSILE INTERCEPT AERIAL, MIM-104

5-19. The missile, from front to rear, consists of a radome, guidance section, warhead section, propulsion section, and control actuator section. The Patriot missile is mounted within a canister (figure 5-7) that functions as a shipping and storage container and as a launch tube. Guided missile canisters are stacked into groups of four per LS (PAC-2).

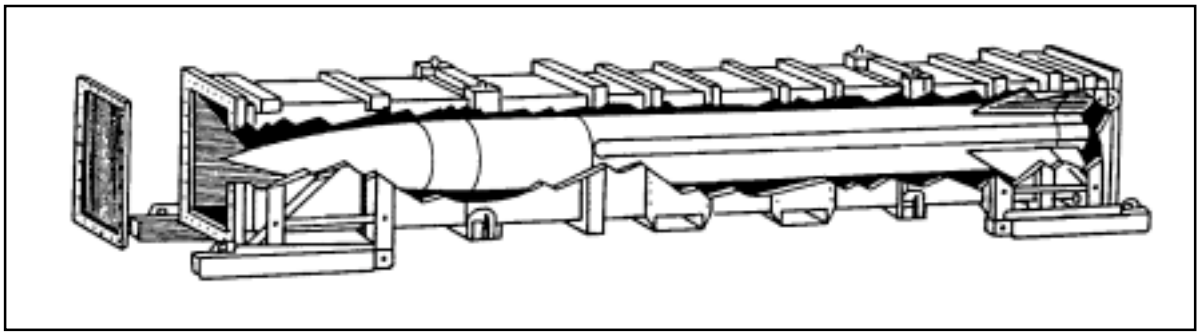


Figure 5-7. Missile Canister

5-20. A desiccant indicator on the aft end of the canister monitors the humidity. A single umbilical cable connection interfaces the canister with the LS and provides the means for status monitoring, preheating, and launching.

5-21. The missile has four clipped-delta, movable, tail-control surfaces, and is propelled by a single-stage, all-boost solid-propellant rocket motor (figure 5-8, page 5-8). BITE checks missile readiness and provides GO or NO-GO logic for successive events in the countdown. A malfunction in any lead-in event in the missile activation and arming sequence will prevent rocket motor ignition. Any defect is automatically reported to the WCC in the ECS.

5-22. The standard Patriot missile (MIM-104) was the first type fielded and contained an analog fuze. This fuze was replaced by a digital version with the fielding of the MIM-104A. Both of these missiles provide excellent performance against ABTs and adequate performance against TBMs.

5-23. To counter the long-range ECM threat the MIM-104B, or standoff jammer countermeasures (SOJC) missile, was fielded in the late 1980's. The guidance and navigation hardware was modified to allow the SOJC missile to fly a lofted trajectory to the jamming source and seek out the strongest emitter during the terminal phase of missile flight. The SOJC missile can fly three times longer than the standard missile without the uplink/downlink

between the RS and missile. The SOJC missile retains the same performance against ABT and TBM as the standard missile.

5-24. The Patriot Advanced Capabilities 2 (PAC-2) missile, MIM-104C, was fielded during Operation Desert Shield and Operation Desert Storm to counter the advanced TBM threat. A new warhead and dual-mode fuze was added to the missile. The new warhead contains a more powerful explosive and larger fragments designed to place sufficient kinetic energy on the warhead section of threat TBMs to achieve a Warhead Kill. The dual-mode fuze allows the PAC-2 missile to retain ABT performance and also optimize performance against TBM. The system software based on the mission selected for the missile sets the fuze mode.

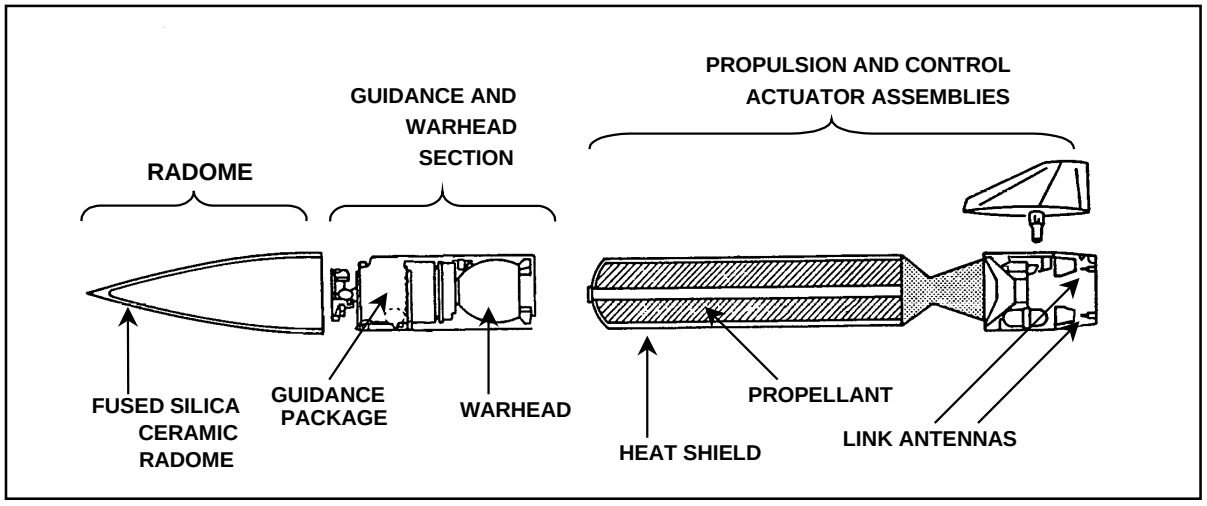


Figure 5-8. Patriot Missile Major Sections (MIM-104C)

5-25. The Guidance Enhancement Missile (GEM) is an improved PAC-2 missile. A Low Noise Front End (LNFE) and improved fuze have increased lethality and expanded TBM engagement volume.

5-26. The Patriot Advanced Capability (PAC-3) missile is to be incorporated into the Patriot air defense system. It will provide defense against tactical ballistic missiles, advanced cruise missiles, and other air-breathing threats in the presence of electronic countermeasures and rough terrain.

5-27. Rather than relying on proximity detonation that can simply redirect or break up an incoming threat, the PAC-3 missile hits the target warhead to assure complete destruction. The PAC-3 missile achieves its hit-to-kill capability through the combination of an extremely accurate seeker coupled with exceptionally rapid airframe response. The missile also utilizes a lethality enhancer that is designed to increase the performance against air-breathing threats. There are 16 PAC-3 missiles per Patriot launcher (versus four PAC-2 missiles per launcher) and eight launchers per Patriot battery.

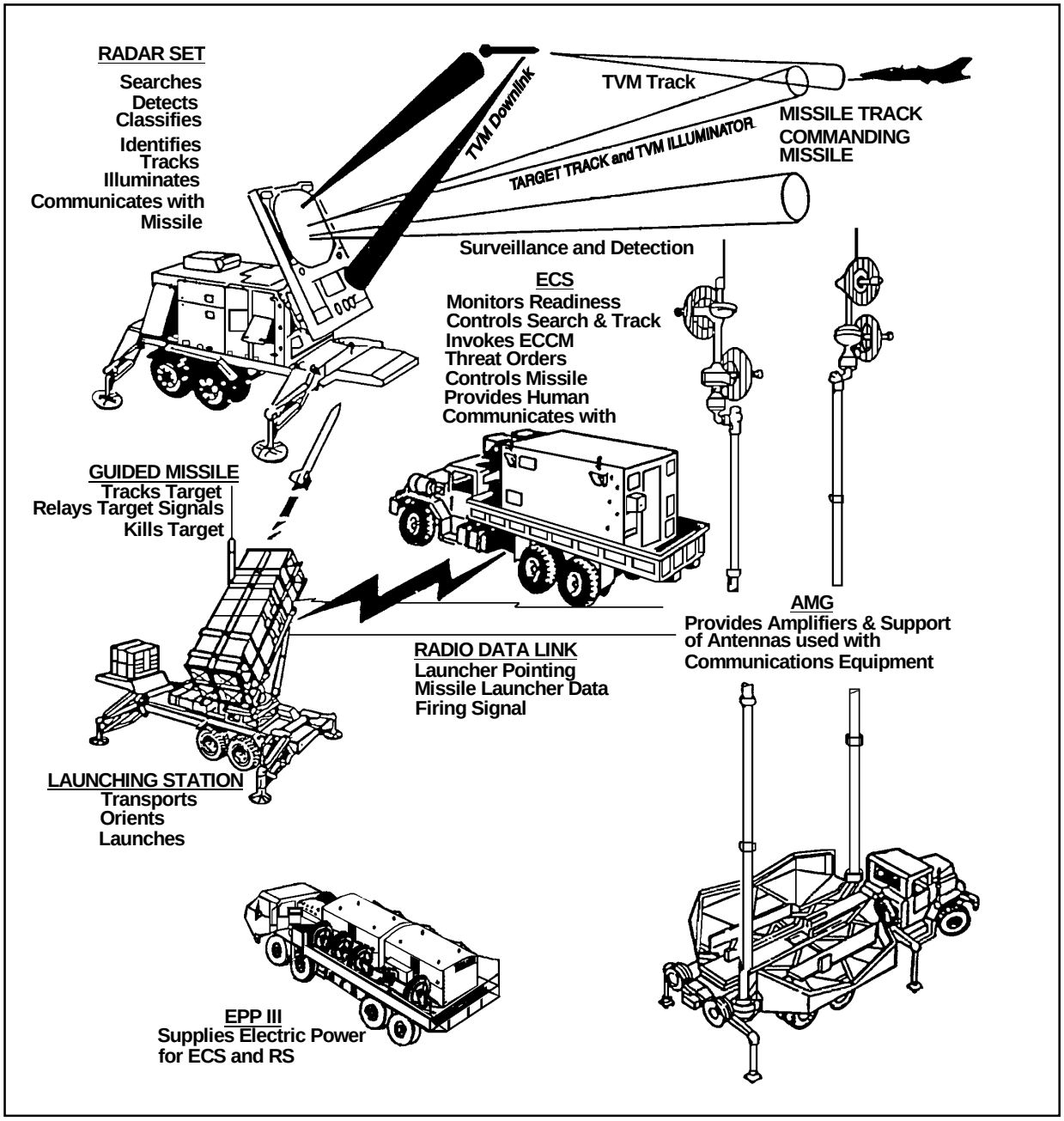


Figure 5-9. Patriot Fire Unit Operations

SYSTEM OPERATIONAL OVERVIEW

5-28. The Patriot system has four major operational functions: communications, command and control, radar surveillance, and missile guidance. These four functions combine to provide a coordinated, secure, integrated, battalion-level, mobile AD system capable of defending designated assets against TBMs and ABTs in an ECM environment.

INFORMATION AND COORDINATION CENTRAL

5-29. The ICC provides the automated data processing (ADP) and communications capabilities that are required to integrate with other AD systems. The ICC communicates with the air defense brigade tactical operation center (TOC-AMDPCS) using either the Army tactical data link-1 (ATDL-1) or tactical digital information link-B (TADIL-B) data link. In the absence of a brigade TOC, the ICC can communicate directly with elements of the USAF Tactical Air Control System/Tactical Air Defense System (TACS/TADS) using either TADIL-A, TADIL-B, or TADIL-J data links.

5-30. The ICC can interface with other weapons surveillance and intelligence systems using communications equipment mounted in the Tactical Command System (TCS). The ICC receives intelligence and early warning information from the CTT-H/R terminal and can establish an UHF TADIL-A data link using the TADIL-A suite of equipment in the TCS.

FIRE UNIT TARGET ENGAGEMENT SEQUENCE

5-31. **Surveillance and Detection**. The RS searches the surveillance area and detects, identifies, tracks, and illuminates targets. The ECS receives target track data from the RS and processes this information within the WCC. Targets are assessed and identified as unknown, friendly, or hostile. When a target has been identified as hostile, it may be engaged once the WCC sends a launch command to the selected LS. The LS receives its launch command from the WCC by way of fiber optic communications or by way of a VHF link, and a selected missile is launched. The RS acquires the launched missile and a two-way data link is established with the ECS WCC through the RS.

5-32. **Track via Missile**. The Patriot missile is commanded to the vicinity of the target by the WCC and then the on-board missile seeker acquires the target. The target is then TVM, while the two-way data link is maintained at an increased rate. The missile moves to the intercept point while the RS illuminates the target.

5-33. **Target Intercept**. At the proper time, the missile proximity fuse is armed. This activates the warhead for target intercept and destruction (figure 5-9, page 5-9).

COMMUNICATIONS EQUIPMENT

5-34. **AN/ARC-187 UHF Radio**. The AN/ARC-187 receive/transmit UHF radio is used for TADIL-A operations. It is used in the TCS and ICC.

5-35. **AN/GRC-103 UHF Radio**. The AN/GRC-103, 12-channel, Band III radio set is used in every ICC, ECS, and CRG. Two corner reflector antennas are used for short-range communications, and the AMG is used for long-range communications. Encryption is provided by the KG-194A.

5-36. **AN/GSQ-240 JTIDS Class 2M Radio**. The AN/GSQ-240 radio is a high-speed data radio that provides jam resistant ground-to-air and ground-to-ground data communications. It operates in a time-shared data network providing subscribers access to theater engagement operations surveillance

and targeting information. JTIDS operates in the 960 MHz to 1215 MHz frequency range.

5-37. **AN/TRC-170 Radio Terminal Set**. The AN/TRC-170 radio provides tactical multichannel digital troposcatter or line-of-sight systems for transmission of analog and digital traffic. It operates in the 4 to 5 GHz ranges with 8 to 144 channels and is housed in a HMMWV mounted shelter. It is used at the ICC for interface with the TCS.

5-38. **Commander's Tactical Terminal/Hybrid Receive Unit**. The Commander's Tactical Terminal/Hybrid Receive Unit (CTT/H-R) is a ruggedized, dual channel terminal capable of receiving and processing broadcasts from the Tactical Information Broadcast Service (TIBS) intelligence network and other communications networks. It operates within the 225 MHz to 1.4 GHz UHF range. It is used in the ICC and TCS.

5-39. **IHFR-AM**. The AN/GRC-193A medium/high power radio set is used at battalion, and brigade CPs primarily as backup communications for C2 when at a static position. The AN/GRC-213 low power radio set is used at firing batteries. Some units are using the AN/GRC-106A radio sets until replaced with AN/GRC-193A or AN/GRC–213 radios.

5-40. **Mobile Subscriber Equipment**. The mobile subscriber equipment (MSE) consists of an interface box at the ICC hardwired to a small extension node (SEN) van which will transmit the signal to other SENs, and various digital secure and non-secure voice telephones. The purpose is to allow the battalion to communicate with higher echelons, other ADA units, and anyone in the net. MSE is not necessarily an organic asset; a supporting signal company may furnish it. It may be used to transmit TADIL-B and ADTL-1.

5-41. **VHF-FM**. At the battalion level, FM radios are used for command, logistics, administrative, intelligence, and operations networks. SINCGARS are the primary radios for the FM networks.

5-42. **Wire**. WD-1 and 26-pair cables are used to connect elements within the battalion and battery for C2, administration, logistics, and CSS. The wire lines are connected with the UHF equipment to communicate with subordinate, higher, and supporting units.

BATTALION COMMUNICATIONS REQUIREMENTS

5-43. The communications system for Patriot battalions must provide reliable, real-time or near real-time information to dispersed Patriot batteries, higher headquarters, adjacent battalions, and supported units. The communications system must be redundant to provide continuous communications even when the primary system fails. To effectively defeat the air threat, the Patriot battalion must maintain communications to support the following functions:

- Control of the air battle.
- Command, administrative, and logistical lines with higher headquarters, subordinate units, and lateral units.
- Liaison with supported units or the units in whose area the Patriot battalion is operating.

5-44. Each Patriot battalion commander is responsible for establishing an effective communications system. He exercises C2 of organic signal assets through his signal officer. Communications are established from higher to lower, left to right, and supporting to supported (see FM 24-1 for more details). The battalion uses multichannel radio and wire nets to maintain external and internal communications. A communications platoon organic to the Patriot battalion provides external and internal communications for the battalion TOC (extended multichannel radio systems) and limited support to the FU.

5-45. The following digital links is used to transmit data:

- PADIL: An internal digital data link for communication between Patriot battalions and batteries. Patriot batteries are PADIL capable only.
- ATDL-1: A secure, full-duplex, point-to-point digital data link that interconnects tactical air control systems and Army or Marine tactical air defense systems.
- TADIL-A: A secure, half-duplex, netted digital data link normally operated in a roll-call mode under control of a net control station to exchange information between land-based, airborne, and shipboard tactical data systems. NATO's equivalent is Link 11.
- TADIL-B: A secure, full-duplex, point-to-point digital data link used to connect Patriot brigades and SHORAD units to the CRC and other points. NATO's equivalent is Link 4.
- TADIL-J: A secure, high capacity, jam-resistant, nodeless data link which uses the Joint Tactical Information Distribution System (JTIDS) transmission characteristics and the protocols, conventions, and fixed-length message formats defined by JTIDS. It is a time-shared net used by airborne, shipboard, and land-based tactical combat operations. NATO's equivalent is Link 16.

EXTERNAL COMMUNICATIONS

5-46. External communications are established with the ADA brigade and adjacent Patriot battalions. The battalion is also capable of communicating with a CRC, SHORAD battalion, THAAD battery, or a Hawk battalion.

5-47. **ADA Brigade**. Communications with the ADA brigade supports air battle C2. It also facilitates administrative, logistical, operational, and intelligence functions. Voice and data links are established via multichannel radio and MSE between brigade and battalion.

5-48. The EAC ADA brigade uses MSE resources to establish and maintain an MSE network between the brigade and subordinate battalions. The corps ADA brigade establishes an MSE network using MSE assets from the corps signal brigade. The primary means of communications with brigade is MSE for all networks (data link, IRR, ADC, brigade command, and brigade admin/log). SINCGARS is the secondary means of communications with the brigade for the ADC, brigade command, and brigade admin/log networks.

5-49. Generally, three dedicated circuits are used for control of the air battle. One circuit is dedicated to automatic data link connectivity that uses either

TADIL-B or ADTL-1. The brigade and battalion tactical directors (TD) use the second circuit for the identification function. This is called IRR and is usually established on party line two. The brigade and battalion tactical director assistants (TDA) use the third circuit for engagement functions. This is called ADC and is usually established on party line one. The brigade command and admin/log networks are accessed via MSE user terminals (DVNT/DSVT) on an as needed dial-up basis.

5-50. IHFR-AM is used as a backup voice system for ADC and IRR. Battalions establish the AM net with brigade to pass messages and facilitate command, control, and coordination with higher echelons. Because of effective communications using MSE and SINCGARS, only a backup AM capability between battalion and brigade is required.

5-51. **Adjacent Patriot Battalions**. A Patriot battalion may establish a UHF multichannel communications system with an adjacent Patriot battalion. Generally, each battalion for this external communications link uses one terminal of a CRG. The EAC ADA brigade can also establish the link. Because the Patriot UHF equipment provides a more effective link, use of a CRG is recommended for interbattalion communications. Battalions can exchange selected information using the Patriot air defense information language (PADIL) at a data exchange rate of 1,200 bits per second. The information is exchanged to improve fire and track coordination.

5-52. **Supported and Supporting Unit**. Patriot battalions establish communications with the supported unit or the unit in whose area the battalion is operating. Supporting units establish communications with the supported unit. Normally, the direct support (DS) Patriot Maintenance Company collocates with or sends a liaison element to the Patriot battalion headquarters. If this is not feasible, the DS Patriot Maintenance Company enters the Patriot battalion VHF-FM administrative and logistics net. All other units that provide support to the Patriot battalion on an area basis normally do not establish communications with the Patriot battalion. The ADA brigade establishes communications with the COSCOM and TAACOM to provide support for Patriot units.

INTERNAL COMMUNICATIONS

5-53. Internal communications are established with each Patriot FU to support the battalion command function. Internal communications also facilitate control of the air battle, administrative, intelligence, operations, and logistics functions, using UHF multichannel and VHF-FM nets.

5-54. **Multichannel Radio Systems**. Patriot battalions use organic resources to establish a multichannel radio network to each subordinate battery. When collocated, an FU can connect via specialty cable directly to battalion. The C^2 structure is heavily dependent upon communications for efficient operations. To pass real-time air battle and air traffic information, automatic data links must be established.

5-55. To effectively fight the air battle, each FU needs three UHF circuits. One channel on each radio is used for the multirouting of data on the automatic data link circuit. Normally, for standardization, channel four is

used. An engagement voice circuit, called ADC, is established using channel one and party line one. An intelligence and radar reporting (IRR) circuit is established using channel two and party line two. An additional circuit is established using channel three and party line three. This is a maintenance circuit and is not used for control of the air battle. Patriot battery TCA and battalion TDA use the ADC net. Patriot battery TCO and battalion TD use the IRR net.

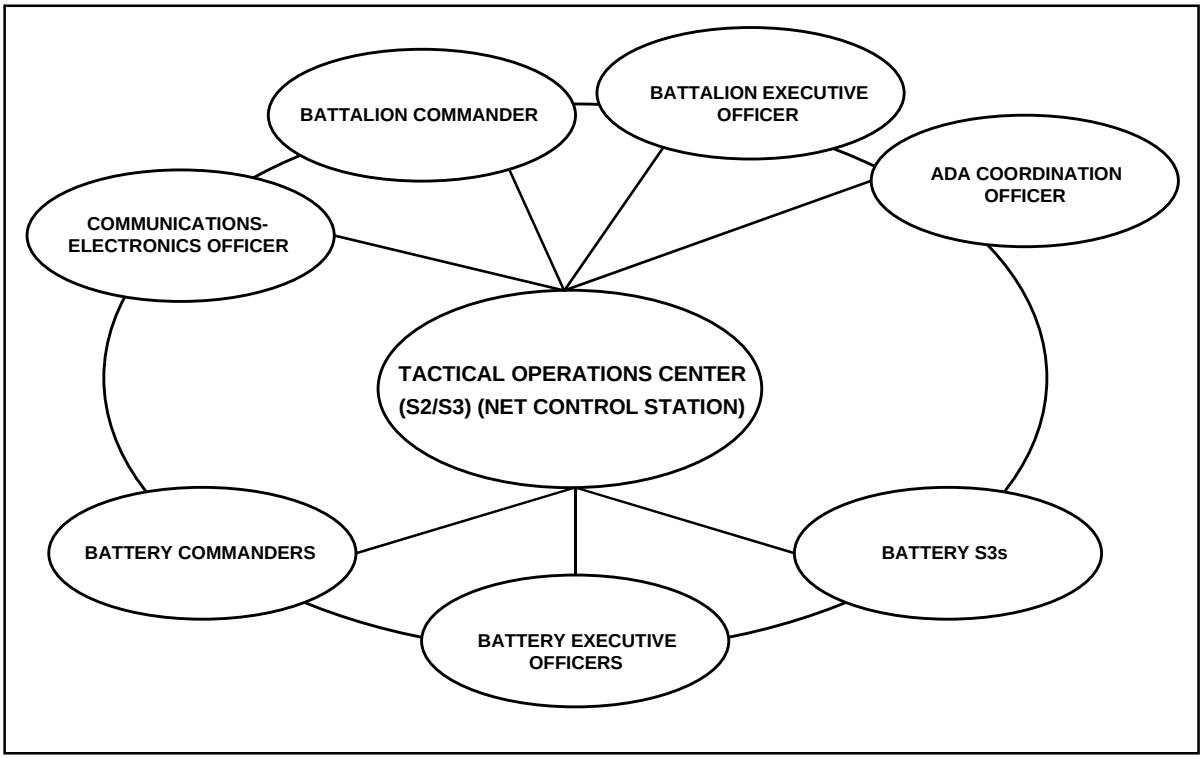


Figure 5-10. Battalion FM Command Net

5-56. **Battalion Command FM Net**. This net provides communications for the command function within the battalion headquarters (figure 5-10,). It is used as the primary C2 net during movements and as a secondary net when in a static location.

5-57. **Administration, Intelligence, Operations, and Logistics**. Normally, the UHF system that provides communications for control of the air battle also supports other functions. Since the UHF system is operational most of the time, it is also the primary means for the staff to provide C2 of the FU. The total number of circuits is limited by the 12 external wire connections at the ICC. These 12 circuits must provide connections to brigade and each battery. Generally, each battery has a minimum of one circuit and will frequently have more than one circuit. These UHF circuits are connected to switchboards at the battalion and battery.

5-58. The ICC is linked to the battalion TOC and the Battalion Maintenance Center by wire. This net allows for rapid communications between key elements of the TOC and the ICC. It can be used to cross-tell time-sensitive

air battle data such as a change in the airspace control order (ACO). Maintenance support can also be requested without leaving the ICC.

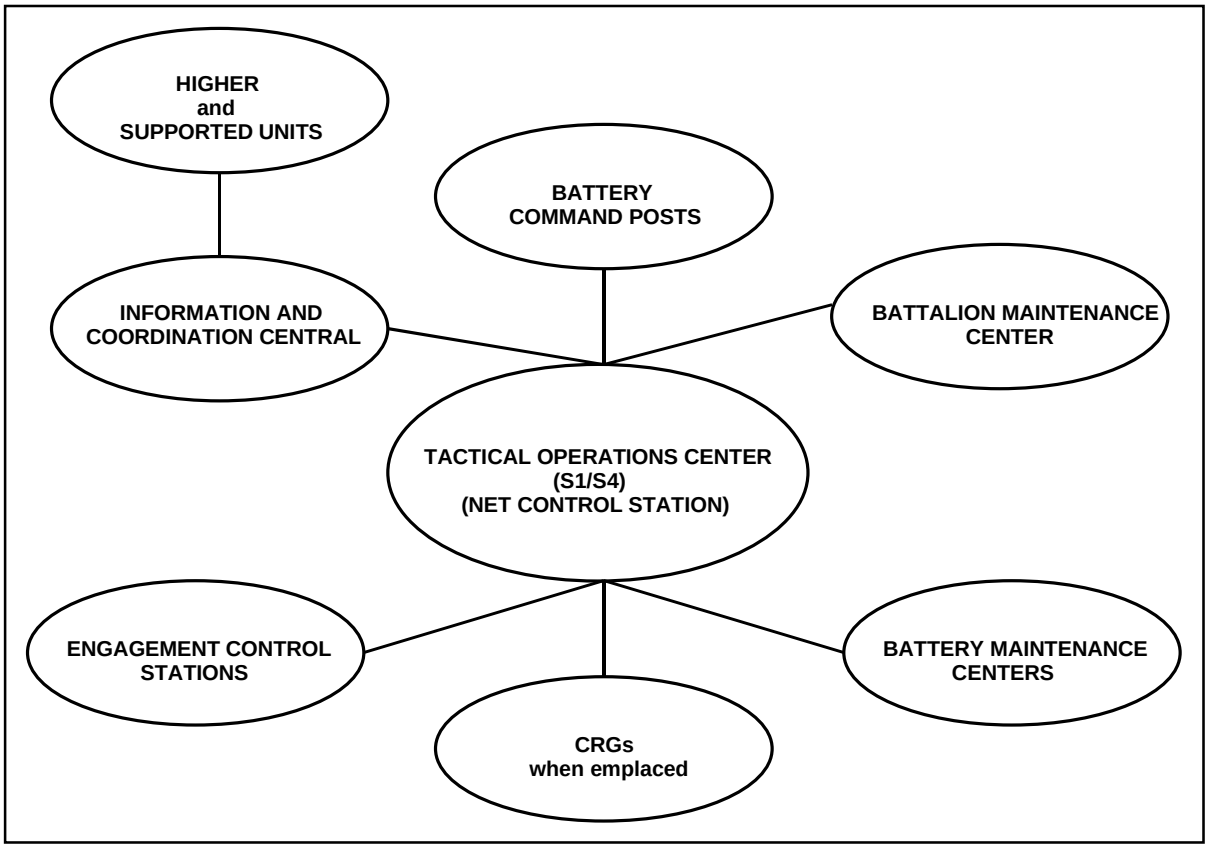


Figure 5-11. Battalion Admin/Log Net (UHF)

5-59. An UHF radio link provides administrative and logistics C2 (figure 5-11). The net control station is located at the S1 and S4 van. Every station in the net is secure. The net is routed through the ICC with UHF links to higher and supported units.

BATTERY COMMUNICATIONS REQUIREMENTS

5-60. The communications system for a Patriot battery is composed of three elements. These elements are the C2 net, data net, and the wire net.

5-61. **Fire Unit Command FM Net**. The purpose of this net is to provide communications for the battery command function (figure 5-12, page 5-16). The net control station is the battery CP. This net is primarily used during unit moves. When the battery is emplaced, the VHF-FM net is used as a secondary means of communications.

5-62. **Fire Unit Operations Net**. This net is used for C2 of the fire unit when it is emplaced. The net control station for the battery operations net is the battery CP. Wire lines connect all elements in the net. A switchboard at the CP provides a means of control for the battery commander (figure 5-13, page 5-17).

5-63. **Patriot Battery Data Net**. Fiber-optic cables link the ECS to the launching stations. This is to launch missiles and to establish availability and status of missiles. Data radio transmissions are used as backup. The net is controlled at the ECS by special purpose radio equipment that provides reliable transmission of low-data rate messages over a short path. All command messages originate at the ECS, requiring a slaved response from the LS in the form of a status message. The LS cannot originate data communications. This is the first net established during battery emplacement.

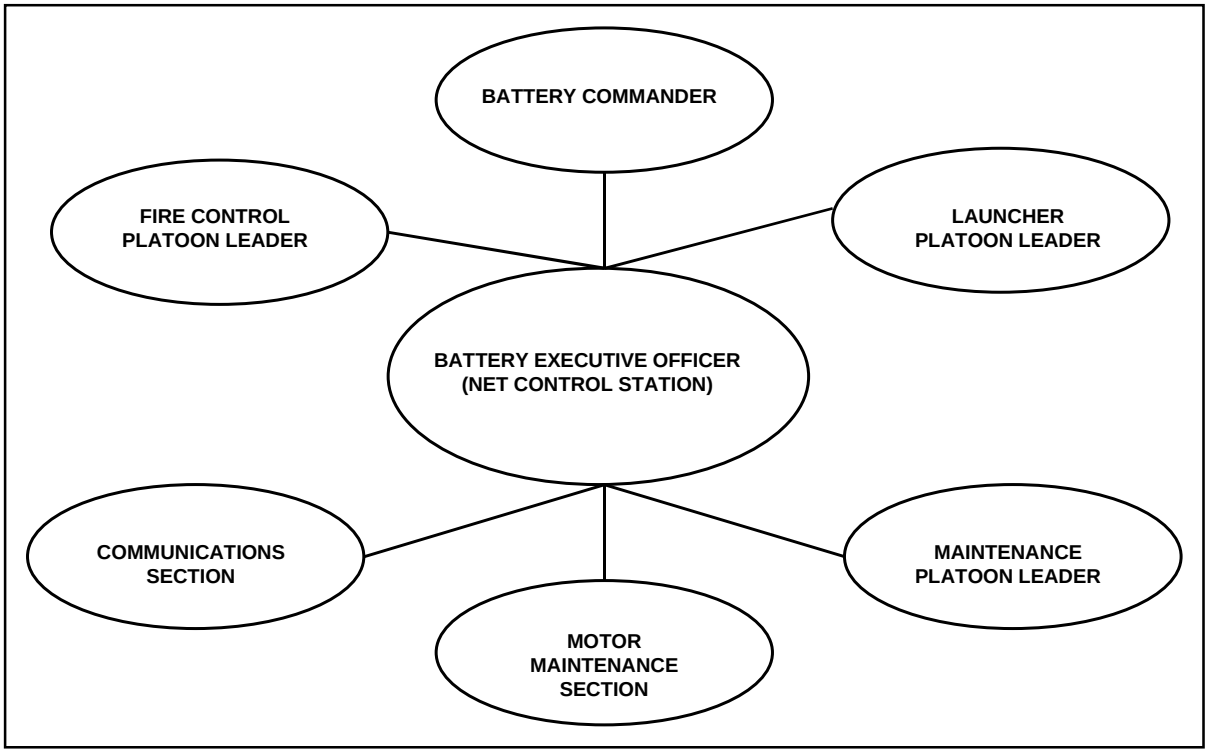


Figure 5-12. Battery Command Net (FM)

5-64. **Battery Communications Means**. Wire is the primary means of communications between elements of the battery. FM radios are used only during movement and until the wire net can be established. A minimum of one circuit to the battalion is available at the switchboard. Normally, the wire lines to the LS connect to ground defense positions.

PATRIOT LOGISTICS SUPPORT

5-65, Organizational level maintenance personnel perform maintenance on Patriot-peculiar equipment in the battalion. This includes preventive maintenance, corrective maintenance and replacement of defective units (called the battery replaceable units (BRU)).

5-66. Organizational maintenance capability is supplemented by Direct support (DS) and General Support (GS) contact teams (formerly intermediate maintenance) to repair problems beyond organizational capability. Standard

Army equipment such as generators, vehicles, and communications equipment in the Patriot system is supported by the conventional Army DS and GS system.

5-67. The Patriot missile is a "certified round" with no field test or repair permitted. If missile maintenance is required, the "certified round" is returned to a Patriot missile facility.

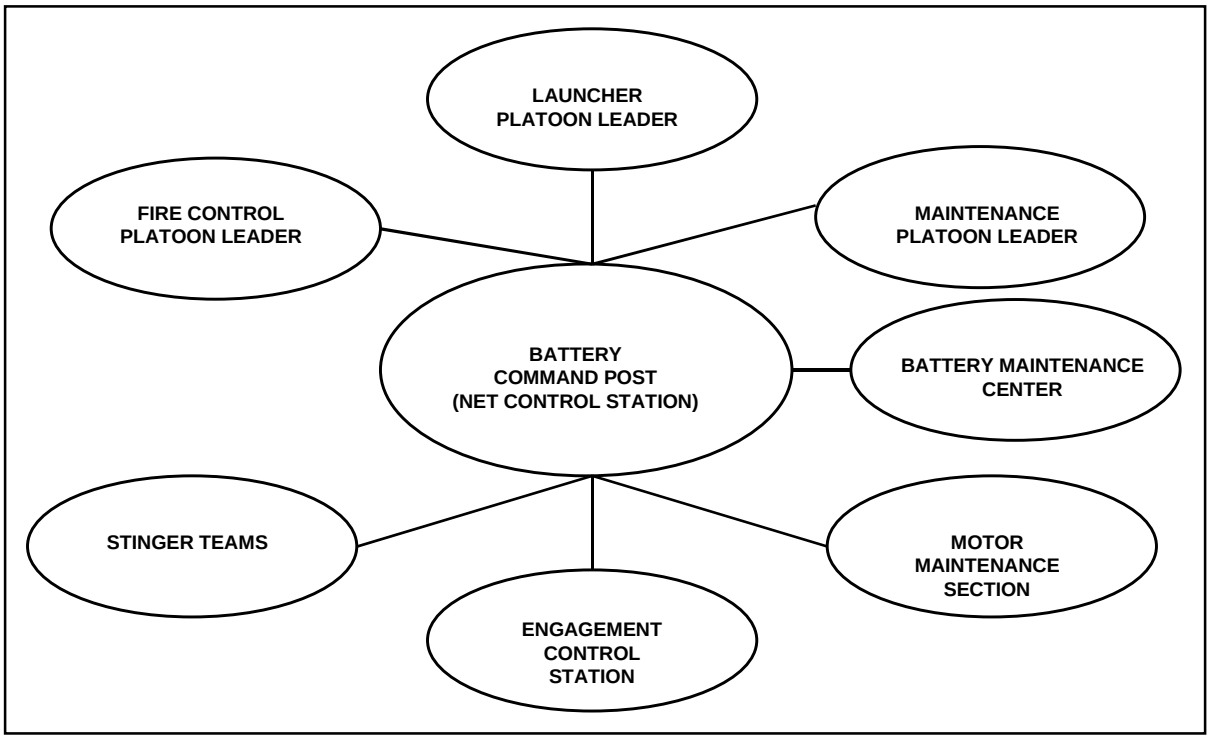


Figure 5-13. Battery Operations Net

PATRIOT AD BATTALION

5-68. Battalion support equipment for Patriot-peculiar equipment at the HHB consists of a battalion maintenance center, and a separately towed power generator. Standard Army support services includes a DS activity for power generation, air conditioning, and communication equipment. For vehicles, theater DS and GS are available.

PATRIOT AD FIRING UNIT

5-69. The Patriot peculiar equipment of the FU is supported with a battery maintenance group (BMG), consisting of maintenance center, small repair parts transporter, large repair parts transporter, and a towed power generator (PU-732/M). Standard Army equipment is supported with portable tools and test equipment stored in the maintenance center.

PATRIOT SUPPORT EQUIPMENT

5-70. Patriot support equipment consists of standard Army vehicles that have been modified and equipped for uses with the Patriot system (figure 5-14, page 5-19). They function as the maintenance and supply centers required for Patriot tactical equipment at the battery and battalion headquarters levels. Repair parts, maintainer tools, test and handling equipment, publications, and maintenance and supply records are stored in the vehicles.

5-71. **Maintenance Center**. A maintenance center (MC) is a semitrailer mounted shop van that contains the tools, test and handling equipment necessary to maintain the Patriot system. It is used at battery and battalion levels. The HHB MC has been configured to function as a small repair parts transporter (SRPT). Power is provided by a PU-732M 15 kw, 400 Hz, diesel generator set, trailer mounted. It is towed by a separate vehicle and provides power for the maintenance center and SRPT.

5-72. **Guided Missile Transporter**. A Guided Missile Transporter (GMT) is a modified HEMTT M985. The GMT is used for delivery, recovery, loading, and reloading of Patriot missiles. A heavy-duty materiel-handling crane is attached at the rear of the vehicle.

5-73. **Large Repair Parts Transporter**. A Large Repair Parts Transporter (LRPT) provides a means to transport and store large, heavy repair parts. It consists of a HEMTT M977 cargo truck with a heavy-duty materiel-handling crane.

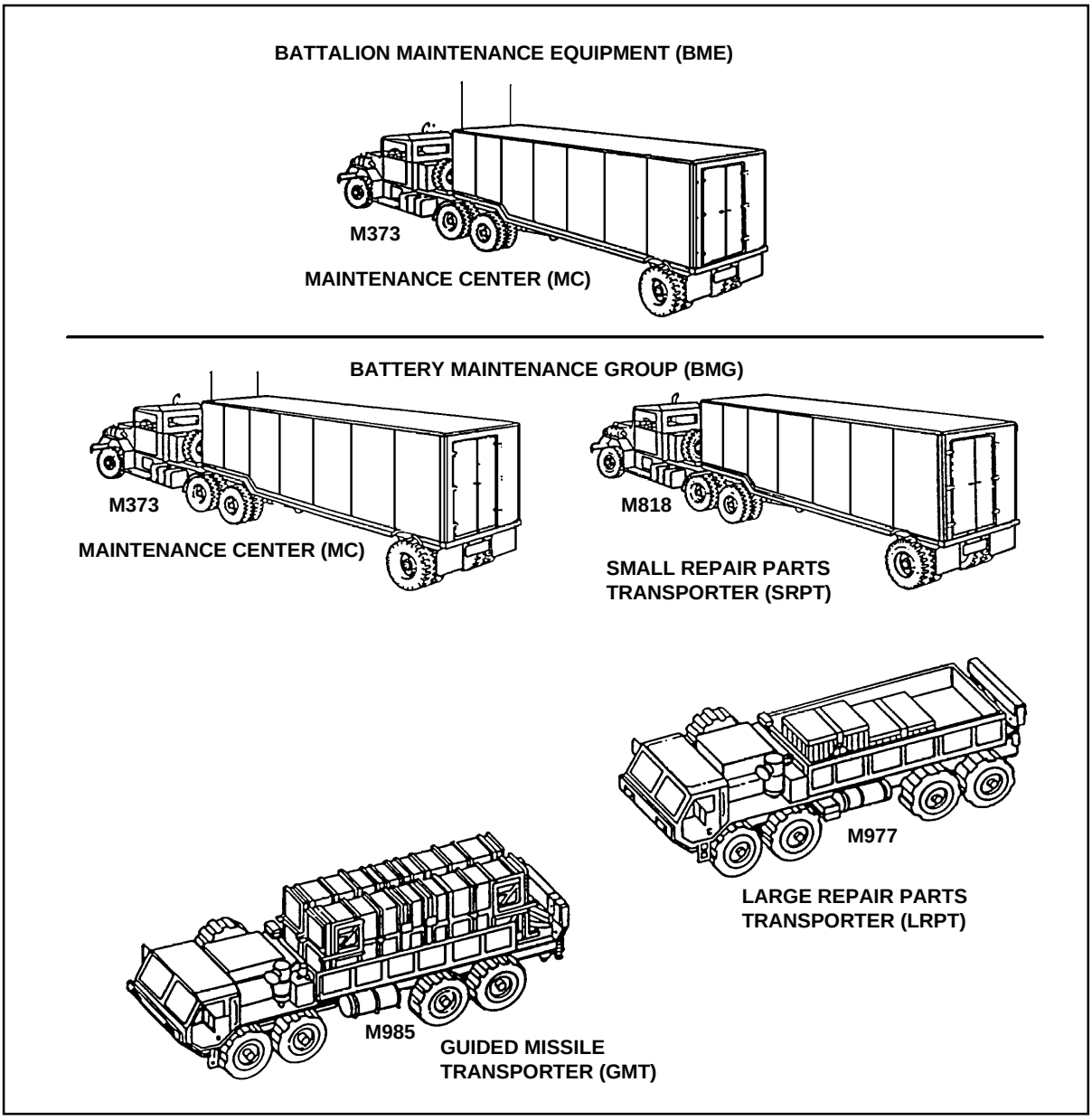


Figure 5-14. Supply and Maintenance Major End Items

Chapter 6

Command and Control Systems

This chapter discusses the command, control, communications, and intelligence collecting systems used by the Air Defense Artillery. The systems discussed are the Air and Missile Defense Planning and Control System (AMDPCS), Tactical Command System (TCS), Patriot Master ICC (MICC), and FAAD Command, Control, Communications and Intelligence (C3I).

AIR AND MISSILE DEFENSE BATTLE COMMAND ORGANIZATIONS

6-1. ADA commanders and leaders organize their personnel and equipment to command and control their units. There are three types of Command and Control (C2) organizations, which are standard in ADA units: command posts (CP), tactical operations centers (TOC), and fire direction centers (FDC).

COMMAND POST

6-2. The principal facility employed by the commander to control operations is a CP. The commander is located anywhere on the battlefield where he can best command the force and is only present at the CP when necessary. A CP consists of facilities for the commander, coordinating staff, and special staff. The organization of the CP reflects the commander's needs. CPs can be organized by echelon, for example, a tactical CP, main CP, and rear CP. The commander may form an alternate or assault CP. ADA units from AAMDC to platoon level form CPs tailored to their needs.

6-3. A command post is organized to perform the following functions:

- Monitor the execution of operations.
- Synchronize combat activities to sustain tempo and adjust the plan to fit the situation.
- Maintain the current operations situation.
- Effectively manage logistics ensuring a continuity of combat consumables.
- Provide a focal point for the receipt and development of intelligence.
- Plan future operations.
- Monitor combat operations of supported, adjacent, and higher echelon organizations.
- Provide situational information to higher headquarters.

TACTICAL OPERATIONS CENTER

6-4. A TOC is a sub-element of a headquarters CP with members of the commander’s staff. A TOC consists of a physical grouping of the staff

elements concerned with current and future tactical operations and tactical support. A key standardized, digitized element of equipment in the AAMDC and brigade TOCs is the Air and Missile Defense Planning and Control System. At the battalion TOC level, the key standard, digitized equipment is the Air and Missile Defense workstation, which is completely compatible with the AAMDC and brigade equipment.

FIRE DIRECTION CENTER

6-5. A fire direction center is that element of a command post by means of which the commander exercises fire direction and/or fire control (engagement operations). The FDC receives target intelligence and fire control orders and translates them into appropriate fire directions and fire distribution.

AIR AND MISSILE DEFENSE PLANNING AND CONTROL SYSTEM

6-6. The AMDPCS is a mission essential system that provides ADA commanders, staffs and crews with automated capabilities to enhance the execution of air and missile defense operations. The AMDPCS is composed of a set of modular, reconfigurable, and standardized automated data processing equipment, based on common hardware and software (CHS) developed for the Army Battle Command System (ABCS). The AMDPCS components will be designed for use with variants of the army standard integrated command post system (SICPS) appropriate to the mission and mobility requirements of the supported unit. The reconfigurable nature of the AMDPCS provides an inherent “jump TOC” capability to support limited AMDPCS operations. A portion of the AMDPCS is deployed into a theater or new area of operations to provide a capability to perform critical command, control, communications and intelligence (C3I) functions until the entire AMDPCS is deployed. Appropriate configurations of the AMDPCS will be fielded at all echelons of command and control.

6-7. The AMDPCS integrates all air and missile defense sensors, weapons and C3I capabilities into a cohesive, synergistic system capable of minimizing fratricide, protecting the force and defeating or neutralizing the air and missile threat. It provides the automated interface for AMD elements at theater and below with the Army Battle Command System (ABCS) and the Army Global Command and Control System (AGCCS), allowing unit commanders and staffs to plan, coordinate and control the AMD fight. The AMDPCS will also be capable of joint service information exchange and interfacing with appropriate allied C3I systems.

OPERATIONAL CONCEPT

6-8. The AMDPCS is the focal point for air and missile defense planning. It provides the means to horizontally and vertically integrate Army, joint and combined forces to synchronize the actions of all AMD elements on the battlefield.

6-9. The AMDPCS provides a commander the timely information necessary to assess the situation, decide on a course of action (COA) and direct his forces to act within the enemy’s decision cycle. The system is configurable by operators to automatically collect, process, sort, categorize, classify, correlate,

store and display air and missile track data and battle command information. Finally, the AMDPCS provides the commander an automated data processing and exchange means by which to distribute his decisions, orders, plans and requests to higher, adjacent and subordinate units and the supported force. The AMDPCS integrates engagement operations functions, force operations functions, and liaison functions, while allowing for human intervention in the process if necessary.

Engagement Operations functions

6-10. Engagement operations (EO) are those actions required to defeat or deny the air and missile threat, while protecting friendly air assets. Engagement operations include the following:

- employing sensors
- detecting, classifying, and identifying aerial platforms
- assessing the threat
- nominating targets for attack operations
- directing and controlling engagements of hostile platforms
- assessing engagement results
- disseminating tactical warnings, cueing data, and alerting data to support attack operations and passive defense
- assisting other units in early target detection

6-11. The AMDPCS is capable of performing its EO functions using centralized, decentralized, or autonomous modes of operation. The AMDPCS produces a real or near real-time airspace picture and provides the capability to coordinate Army airspace command and control (A2C2) with other Army, joint and combined elements. Through automated support for EO functions, the AMDPCS allows friendly AMD forces to detect, acquire, classify, and identify aerial platforms early and at great ranges, thereby minimizing fratricide and increasing lethality against hostile targets.

Force Operations Functions

6-12. Force operations (FO) are those actions that are required to plan, coordinate, sustain, and synchronize the air, land and sea battle. FO involve the preparation and positioning of friendly forces for maximum exploitation of enemy weaknesses and include the horizontal and vertical exchange of situation awareness and battle command information within the AMD structure, as well as with the other Army, joint and combined forces in the theater. Situation awareness involves continuous updates of the activities and locations of key friendly and enemy elements.

6-13. By providing automated support for FO functions, the AMDPCS reduces the time requirements and increases the accuracy and reliability of the staff planning processes necessary to support AMD operations. Automation of intelligence, operations, logistics and personnel actions, reports and requests ensures timely information and responses are provided to, and shared among, AMD elements and supported and supporting units so as to enhance the AMD unit's capabilities to perform the assigned mission.

Liaison Functions

6-14. The AMDPCS supports liaison functions by providing an automated means for air and missile defense elements at division, corps and theater levels to exchange warnings, alerts, situation awareness data, and battle command information. It also integrates with the airspace control authority, the identification and engagement authorities and space-based and airborne intelligence and early warning platforms.

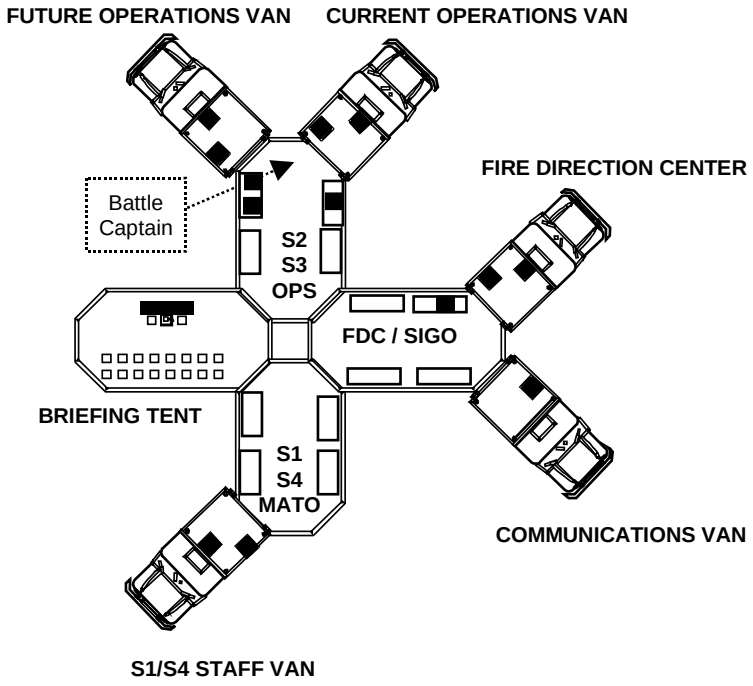


Figure 6-1. Typical ADA Brigade AMDPCS Layout

AMDPCS COMPONENTS

6-15. The AMDPCS brings two major items of automated data processing equipment to the battlefield: the Air Defense Systems Integrator (ADSI) and the Air and Missile Defense Workstation (AMDWS). The ADSI is used at the AAMDC and AMD brigade levels, while the AMDWS is used at echelons down to battery level. Figure 6-1 shows a typical physical layout of an ADA brigade AMDPCS.

6-16. AMDPCSs configured for operations at or above battalion level have significantly greater force operations capabilities than those designed to support the firing batteries and platoons. By contrast, AMDPCS capabilities at firing battery and platoon levels are largely in the engagement operations functional area. Table 6-1 lists all components of the AMDPCS that are configurable for different echelons.

Table 6-1. AMDPCS Components and Functions

Air & Missile Defense Workstation (AMDWS)	Provides real time air picture as a planning tool for radar coverage and system firing fans.
Air Defense System Integrator (ADSI)	EO and FO operations at brigade and above level.
All Source Analysis System (ASAS)	Displays EOB and assists in analysis of and receive, print, and plot intelligence reports and imagery.
AN/ARC-187 UHF Radio	Receives UHF TADIL-A data
Army Field Artillery Tactical Data System (AFATDS)	Assists in fire support management, passes launch points and accesses blue artillery database.
Automated Deep Operations Coordination Cell (ADOCS)	Displays units, airspace control means used to plan deep targets through the corps' DOCC. Provides situational awareness to targeting officer.
Central Communications Display (CCD)	Allows the battle captain the ability to view other component displays.
Commanders Tactical Terminal-3 (CTT-3)	Radio UHF receiver for TIBS and TADIL-B.
Contingency Theater Automated Planning System (CTAPS)	Used to download ATO/ACO and provide input to blue planning.
Generic Area Limitation Environment (GALE)	Terrain analysis using resident databases and can do location suitability modeling for threat systems.
Global Command and Control System (GCCS)	Multiservice C3I data
Harris RF-350 HF Transceiver	Receives HF TADIL-A data
Interim Pager Alert Warning System (IPAWS)	Provides missiles warning and force warning via pagers.
Joint STARS Common Ground Work Station (CGWS)	Provides MTI/SAR data and initiates RSR.
Joint Tactical Information Distribution System (JTIDS)	Receives TADIL-J picture.
Joint Warning (JWARN)	Receives, displays, and transmits NBC messages.
Maneuver Control System (MCS)	Provides comprehensive blue force information and inbound missile warning
Multiple Source Tactical System (MSTS)	Provides real time multispectral imagery and flight following and threat displays.
PSC-7 SATCOM Radio	Receives line-of-sight UHF secure data and voice communications.
Worldwide Origin and Threat System (WOTS)	Receives and correlates JTAGS, ALERT, and TACDR reports and alerts.

6-17. The AMDPCS has the capability to be reconfigured to perform the functions of the next lower or higher echelon AMDPCS. It can be reconfigured

by the addition or deletion of modules, workstations, cells or software or through system initialization procedures IAW the assigned mission and task organization.

TACTICAL COMMAND SYSTEM

6-18. The Patriot Tactical Command System (TCS) is a facility which accommodates the commander and staff of up to ten air defense personnel and provides automated equipment to support force operations (FO) tasks which complement the EO activities in the Patriot ICC. The TCS is mounted on an M934 5-ton expandable van. It is co-located with and interfaces directly to the Patriot ICC using MSE and LAN, uses US Army common hardware and software components, and is powered by a standard US Army 30 kw, 60 Hz generator with UPS backup power.

6-19. Automation is provided through the use of two Tactical Planner Workstations and a communications processor. The TCS workstation standard software package is Air and Missile Defense Workstation (AMDWS) 1.1. Automated functions internal to the TCS include the following areas: defense design (TBM and ABT planning), situation awareness, mission reporting, recording/replay of the air battle, and ICC initialization. The following summarizes the functions performed by the AMDWS:

- Maintain situation awareness of the hostile air threat.
- Provide data required for air intelligence preparation of the battlefield (IPB).
- Maintain situation awareness during ongoing air defense operations.
- Monitor logistical status reports.
- Provide for the interface and data exchange between the TCS and other elements of the ABCS.

MASTER INFORMATION AND COORDINATION CENTRAL

6-20. The Patriot Information and Coordination Central has the capability to function as a master ICC (MICC) fire distribution element. Major features of a MICC include:

- Increased external and internal interfaces
- Brigade wide track management
- Automatic fire distribution and battalion engagement assignment

6-21. A master ICC can work together with external elements. These may be as follows:

- subordinate or lateral battalions (SICC, MICC)
- higher echelons (CRC, TAOC, AWACS)
- up to 12 Fire Units (ECS)

FORWARD AREA AIR DEFENSE C3I SYSTEM

6-22. The FAAD C3I system provides automated engagement operations (EO) and force operations (FO) capabilities at the SHORAD battalion. EO capabilities include near-real-time early warning and target cueing information to SHORAD

weapon systems, friendly aircraft identification, and air-battle management. FO capabilities include automated mission planning, automated staff planning, and interoperability with other command systems. FAAD C3I effectively utilizes joint and combined information by processing the air picture received from USAF E-3 (AWACS), USN E-2C (Hawkeye), and TADIL-B sources such as Patriot.

6-23. Components of the FAAD C3I system include:

- Air Battle Management Operations Center (ABMOC) that monitors and controls the air defense tactical operations for the battalion.
- Army Airspace Command and Control (A2C2) system at the division TOC.
- Sensor/Command and Control (Sensor/C2) system that processes and disseminates track data to firing batteries.
- The Sentinel radar that provides early warning and system cueing information.
- Simplified Handheld Terminal Unit (SHTU) or Handheld Terminal Unit (HTU).

6-24. The ABMOC and A2C2 systems utilize the Army Standard Integrated Command Post System (SICPS) shelter with HMMWV. SINCGARS and EPLRS radios, Mobile Subscriber Equipment (MSE) user terminals (DNVT/DSVT) and the Joint Tactical Information Distribution System (JTIDS) terminal provide communications (voice and data) (figure 6-2, page 6-8). FAAD C3I provides command and control to Avenger, MANPADS Stinger, Bradley Stinger Fighting Vehicle (BSFV), and Linebacker weapon systems and the Sentinel and LSDIS sensor systems. FAAD C3I provides:

- A composite air picture to SHORAD weapon systems from Air and Missile Defense (AMD) sources
- Distributed threat and air battle information to the supported force
- Netted organic sensors (Sentinel, LSDIS)

COMMAND AND CONTROL

6-25. The heart of command and control (C2) is the process of acquiring information, assessing how this information affects current activities, determining a course of action, and directing the implementation of these decisions. The intelligence component provides input to each C2 echelon on the hostile and neutral aspects of the battlefield environment.

6-26. The Command, Control, Communications and Intelligence (C3I) network will allow each SHORAD CP and weapon system to receive:

- target location
- target identification
- target classification
- air defense warning (ADW) and weapon control status (WCS) updates

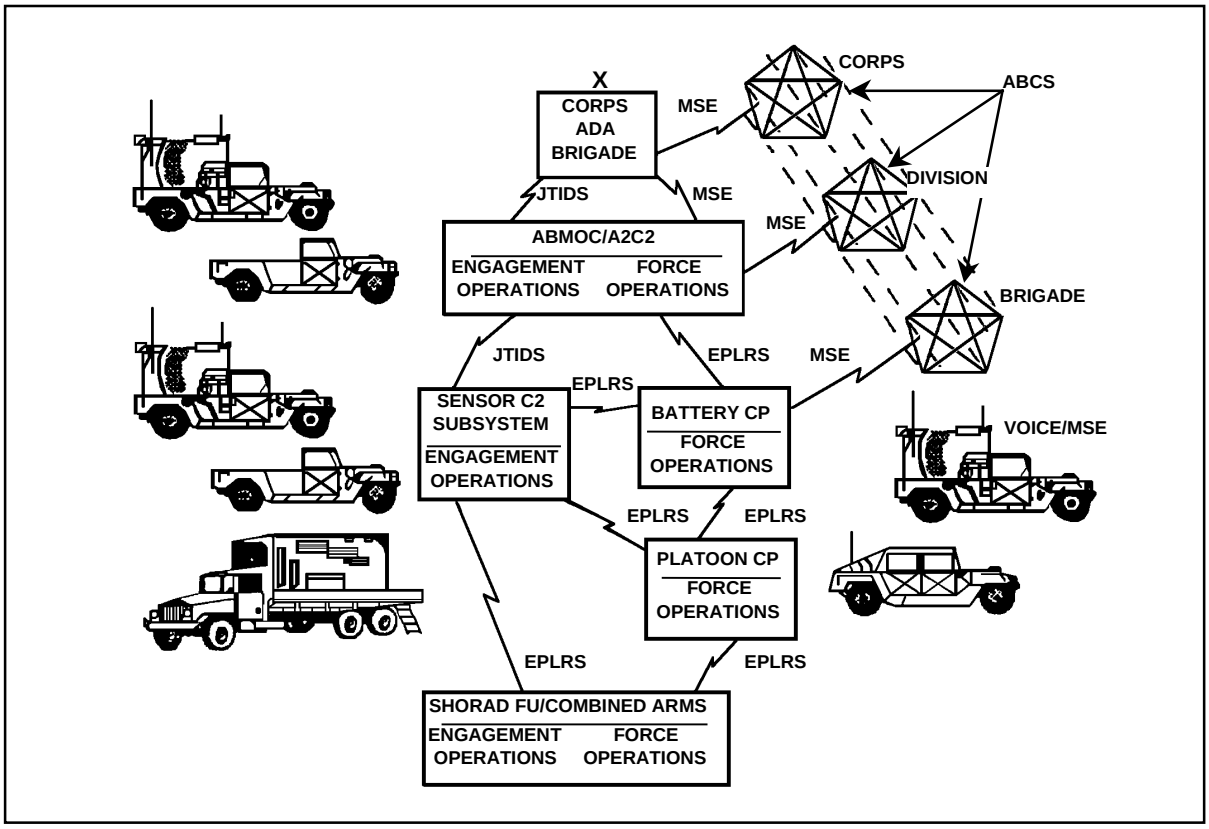


Figure 6-2. FAAD C3I System

COMMUNICATIONS

6-27. Communications and intelligence provide the means to perform the C2 process effectively and in a timely manner. The communications system provides the network that is used to transfer information, orders, instruction data, and intelligence between and within echelons of command. AD commanders must continuously update and coordinate their operations through the integration of communications. Characteristics of FAAD C3I communications are:

- long-range
- mobile
- netted sensors with air battle management operations center (ABMOC) and ADA C2 subsystems
- netted integration (EPLRS only)
- jam resistant
- secure high-speed data distribution
- secure voice communications subsystems

6-28. Major components are the SINCGARS radios, mobile subscriber equipment (MSE) user terminals (DNVT/DSVT), enhanced position location reporting system (EPLRS), and the joint tactical information distribution

system (JTIDS). These components are discussed in the following paragraphs.

Single Channel Ground and Airborne Radio System

6-29. SINCGARS radios are used for both secure voice and digital data in the FAAD C2I equipped SHORAD Battalions. SINCGARS operates in the 30 to 88 MHz frequency range, in 25 kHz steps for a total of 2,320 channels. It can operate in either a single channel or frequency-hopping mode.

Mobile Subscriber Equipment

6-30. Mobile subscriber equipment (MSE) is a common-user, switched communications system of linked switching nodes. The nodes form a grid that provides the force with an area common-user communications system. MSE is digital, secure, and flexible. It contains features that compensate for link failures, functional equipment outages, overload in traffic, and rapid movement of users. FAAD C2I uses Mobile Subscriber Equipment (MSE) to share TADIL-B track data with Patriot battalions and adjacent SHORAD battalions, as well as interface with other Army Battle Command System elements.

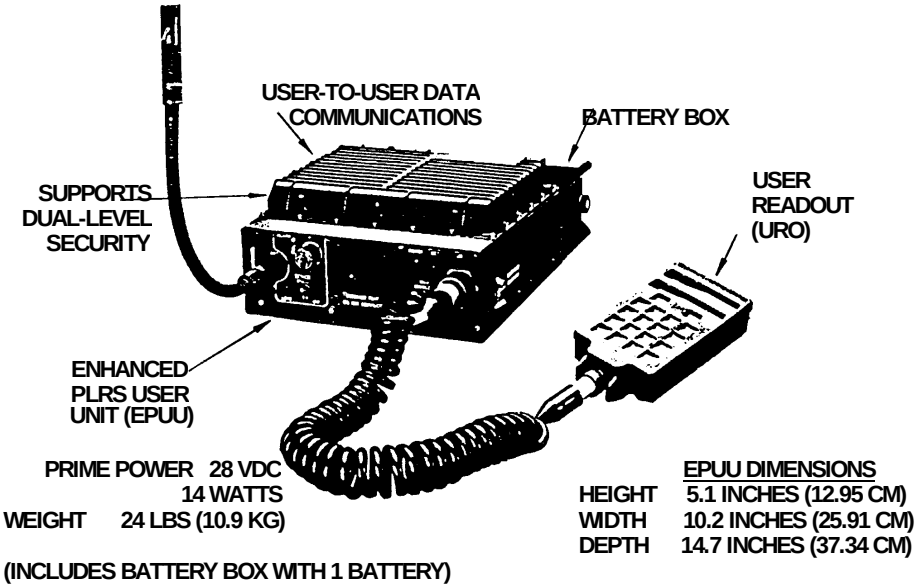


Figure 6-3. Enhanced Position Location Reporting System (EPLRS)

Enhanced Position Location Reporting System (EPLRS)

6-31. Enhanced Position Location Reporting System (EPLRS) radios are used for secure digital data communications (figure 6-3). The EPLRS network supports timely air track broadcast, two-way command and control, communication need-line allocation, and sensor netting. EPLRS resists jamming by waveform design and signal processing techniques, relatively

high values of effective radiated power, automatic network reconfiguration and path redundancy.

Joint Tactical Information Distribution System

6-32. Joint Tactical Information Distribution System (JTIDS) is a jam resistant, secure data and voice communications system used for command, control, and identification. JTIDS provides FAAD C2I with a TADIL-J (link 16) capability to participate on the JDN. JTIDS class 2M radios are located at the divisional level in the Army Airspace Command and Control (A2C2) and at the battalion level in the ABMOC in support of FAAD C2I. The ABMOC and A2C2 use JTIDS to receive long range early warning, classification and identification from the JDN (i.e. AWACS). That data is then correlated with other external sources (i.e. Patriot) and organic sensors, and is then broadcast to the sensor C2 nodes in the battalion. JTIDS provides the ABMOC and A2C2 the means to transmit specific organic SHORAD air tracks (i.e. CM, UAV) to the JDN.

SENTINEL SYSTEM

6-33. The Sentinel is organic to divisional SHORAD battalions, ACRs, and is replacing LSDIS in light and special divisions (figure 6-4, page 6-13). Sentinel is designed to operate in all types of weather, severe ECM environments and survive anti-radiation missile (ARM) attacks. The mission of the Sentinel is to alert the Linebacker, the Bradley Stinger Fighting Vehicle, and MANPADS Stinger teams of hostile and unknown aircraft (FW and RW), cruise missiles, and unmanned aerial vehicles (UAV). It also protects friendly forces from fratricide and provides air situational data to command and control centers.

6-34. Sentinel track data is broadcast to SHORAD weapons and Command Posts through the FAAD C2 system or, in the event a sensor node is not available, directly to the fire units over EPLRS or SINCGARS. The method of transmission is operator-selectable from the remote control terminal (RCT) during initialization.

6-35. The Sentinel system consists of an Antenna-Transceiver Group (ATG) mounted on a high-mobility trailer, and a HMMWV Group consisting of a M1097A1 HMMWV, a MEP-813A 10 kw 400 Hz generator, power conditioning equipment and communications equipment. The system is march-ordered and emplaced by two soldiers and operated by a single soldier. It incorporates automatic fault detection and built in test equipment (BITE). The Sentinel is transportable by aircraft (to include helicopters), rail, or ship.

Sentinel Radar

6-36. The Sentinel radar is a mobile, compact, modular, multifunction, phased-array radar. It consists of a radar antenna unit mounted on top of the transceiver unit. The radar antenna unit also includes an IFF interrogator, an IFF antenna, and an auxiliary ECCM antenna mounted on a single pedestal that rotates during operation. The antenna unit is lowered by hand crank to the stowed position for road march.

Table 6-2. Sentinel Radar Unit Characteristics

Dimensions

Height
- Antenna erected ..... 131.7 inches
- Antenna stowed ..... 94.8 inches

Width (mirrors folded) ..... 85 inches
Length ..... 167.26 inches
Length (with HMMWV) ..... 312 inches
Weight ..... 3,740 lb.

Environmental Characteristics

Temperature
- Operating ..... -50 to 125° F (-46 to 52° C)
- Non-operating ..... -70 to 160° F (-57 to 71° C)

Altitude
- Operating ..... Up to 10,000 feet
- Non-operating ..... Up to 50,000 feet

Wind
- Operating ..... 52 mph with gusts to 75 mph
- Non-operating ..... 65 mph with gusts to 100 mph

Rain ..... 5 inches per hour with winds to 52 mph

Electrical Requirements

Voltage ..... 208 VAC $\pm$ 10% 3-phase; 120 VAC $\pm$ 10%
Power ..... 10 kilowatt, 400 hertz

Mobility

Transport
- Level highway ..... 40 mph
- Graded gravel road ..... 30 mph
- Cross country terrain ..... 8 mph
- Side slope ..... 20 %
- Longitudinal slope 32%

Fording ..... Water up to 30 inches deep

Table 6-3. Sentinel Radar Operating Characteristics

RADAR SEARCH	
Elevation	20° to 25° scan, selectable between -15° and +55°
Azimuth	360° CW or CCW scan
Search Perimeter	> 40 km
RADAR TRACK	
Elevation	-10 through +55°
Azimuth	360° CW or CCW scan
Beam Width	2 x 2° pencil beam
Track Perimeter	40 km instrumented range
RADAR REPORT	
Target Track	Azimuth, elevation, and heading in degrees or mils Range in miles or kilometers Altitude in feet or meters Velocity in feet per second or meters per second
Target Discrimination	Fixed wing or helicopter Unknown, designated unknown, or known/friendly
Jammer Discrimination	Azimuth and elevation in degrees or mils
Report Reference	Respective to DLRP or site MGRS/MSL coordinates
Report Capabilities	FAAD C2I Data Link: track report, IFF/SIF report, and ECM intercept messages EPLRS Radio Link: Track report messages SINCGARS Radio Link: Track report messages
RADAR TYPE	**TARGET TYPE**
X Band	Fixed Wing
3-dimensional Pencil Beam	Rotary Wing
Range-gated, Pulse Doppler	Cruise Missile/UAV
30 RPM rotation (2-second update)	
SURVEILLANCE	
360 Degree Surveillance Volume	
Range	40 kilometer (software instrumented)
Altitude	0-4 kilometer; -10 degrees to +55 degrees
FAAD DATA LINK INTERFACES	
SINCGARS VRC-92A Enhanced Position Location Reporting System (EPLRS) PJHI Hardwire to C2	
ECCM	
Extremely Low Sidelobes	Track on jam strobe
Wide Band Frequency Agile	Variable Pulse Repetition Rate (PRF)
Sector Blank	
IFF	
Modes	1, 2, 3A, and 4
Range	>72 km
Beam width	18° Azimuth, 40° Elevation

Remote Control Terminal

6-37. The Remote Control Terminal (RCT) is a display and control input device used with the Sentinel radar. It is a rugged, compact minicomputer with graphic display screen and multifunction control input keyboard. The Sentinel operator controls the operation of the radar with the keyboard.

6-38. The RCT provides a real-time tactical air picture on a graphic display screen at remote locations. Sentinel radar target tracks are displayed to the operator in target symbology that shows range, elevation, velocity, and track number information.

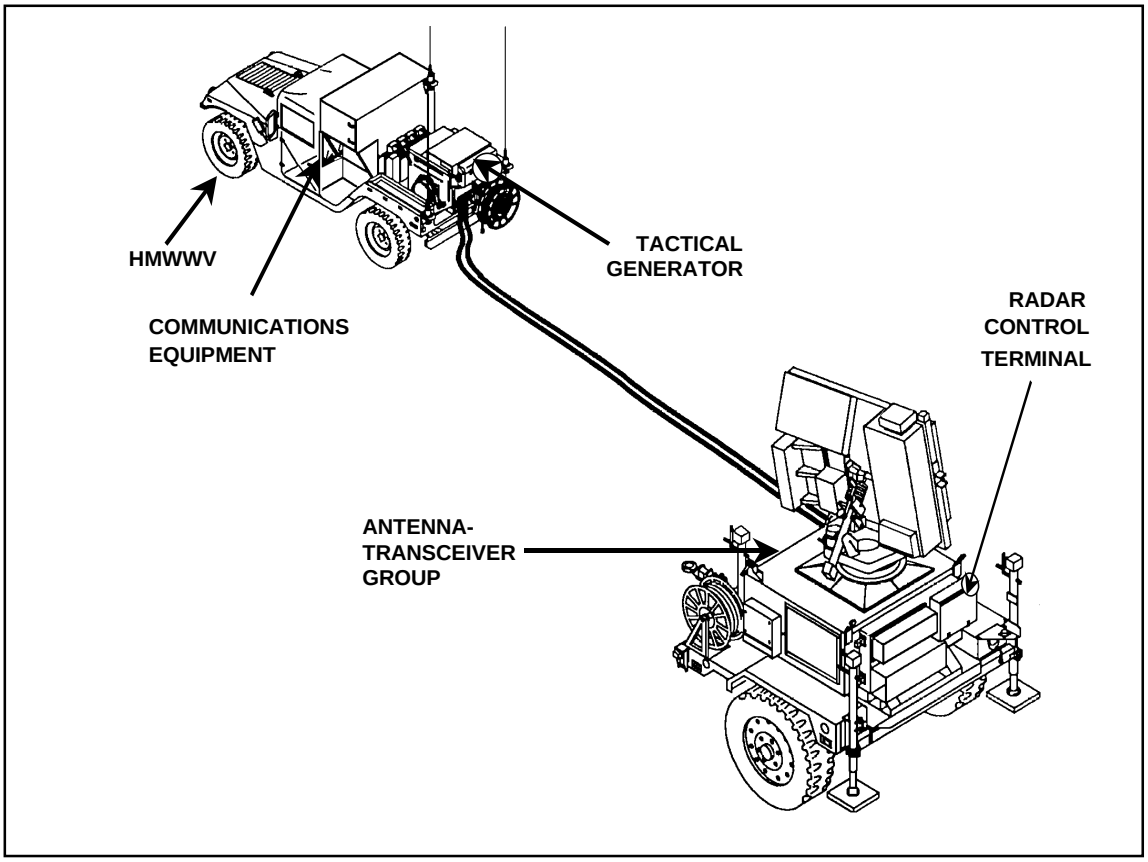


Figure 6-4. Sentinel System

Employment

6-39. Common methods of employment are as follows:

- Method A. Sensor sections are deployed by the sensor platoon leader with staff supervision exercised by the AD battalion S23. The S3 coordinates the selected map positions with the division A2C2 cell. In this method, the platoon leader retains control of the sections.
- Method B. Two sensor teams are attached to each firing battery. The firing battery recommends sensor positions to the ABMOC officer

in charge (OIC). The S3 coordinates these positions with the battalion S2 and division A2C2 cell. The S3 recommends approval or changes, and forwards the approved positions to the firing battery commander.

6-40. The AD battalion commander must consider certain deployment factors to determine which method to use. These factors include but are not limited to the following:

- mission
- deployment of supported forces
- deployment of fire units
- the enemy threat, both air and ground
- terrain
- electronic warfare environment

Chapter 7

Training Devices and Aerial Targets

This chapter discusses training devices and aerial targets available to support Air Defense Artillery systems. The best weapon system in the world is useless without highly trained operators and maintainers. Training devices promote and maintain operator, maintainer, and gunner skills and proficiency while shortening training time and saving resources. Training devices can be simulators, interactive mockups, virtual modeling, static equipment maintenance trainers, and aerial targets. Aerial targets are used to train gunners and crews during gunnery training and systems qualifications.

MANPADS STINGER TRAINING DEVICES

7-1. A number of training devices support Stinger training. Described in the following paragraphs are:

- Field Handling Trainer (FHT)
- Tracking Head Trainer Set (THT)
- Stinger Troop Proficiency Trainer (STPT)
- Improved Moving Target Simulator (IMTS)

STINGER FIELD HANDLING TRAINER

7-2. The Stinger Field Handling Trainer (FHT) is used at the unit level and service schools. The Stinger gunner uses the FHT to practice manual skills of weapon handling, operations, sighting and ranging. The FHT can be used to visually track live aircraft or remotely piloted vehicle target system (RPVTS). It allows the gunner to practice mating and removal of the gripstock, and insertion and removal of the battery coolant unit (BCU). The FHT is the same size, weight, and appearance as the Stinger weapon round. Audio indications of target acquisition and IFF responses are not a feature of the FHT (figure 7-1, page 7-2).

STINGER TRACKING HEAD TRAINER SET

7-3. The Stinger Tracking Head Trainer (THT) has the same seeker and general appearance as the weapon round except for the performance indicator assembly. The performance indicator assembly provides a means to critique the gunner after target engagement when an engagement is, or is not, correctly performed. The THT is used to train gunners in tasks required for engagement of aircraft. It is used at the unit level for sustainment training, at service schools to train entry-level personnel, and in the IMTS for target engagement. A benefit of the THT is quality training for operators and the reduction of ammunition expenditures (figure 7-2, page 7-2).

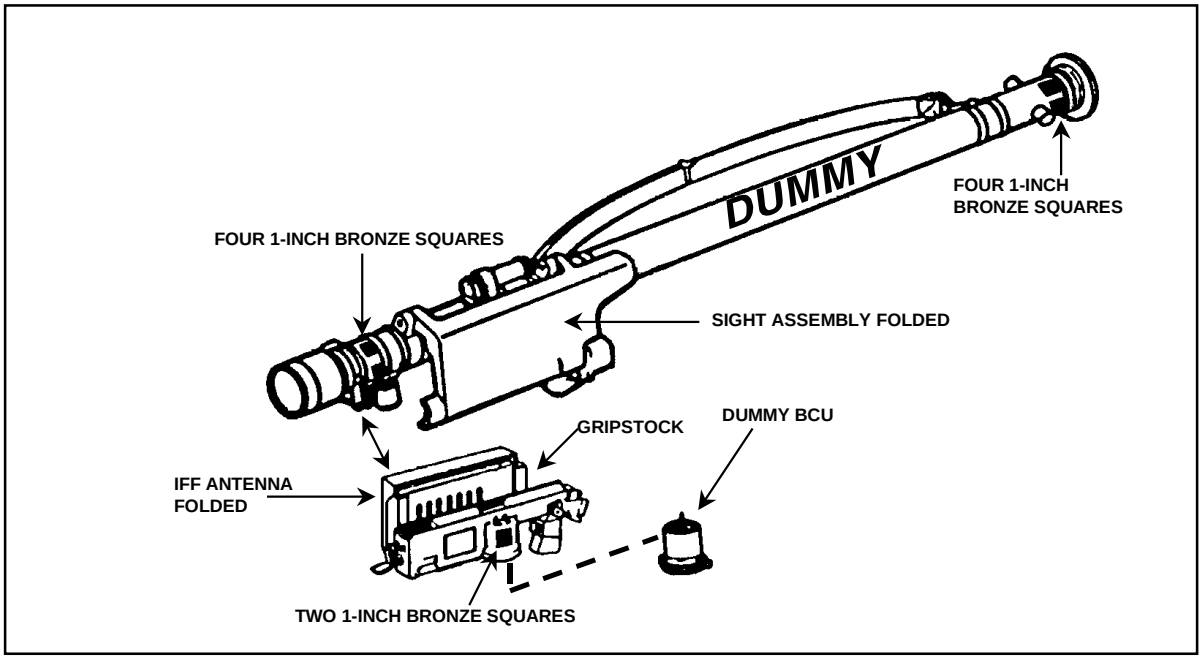


Figure 7-1. Stinger Field Handling Trainer

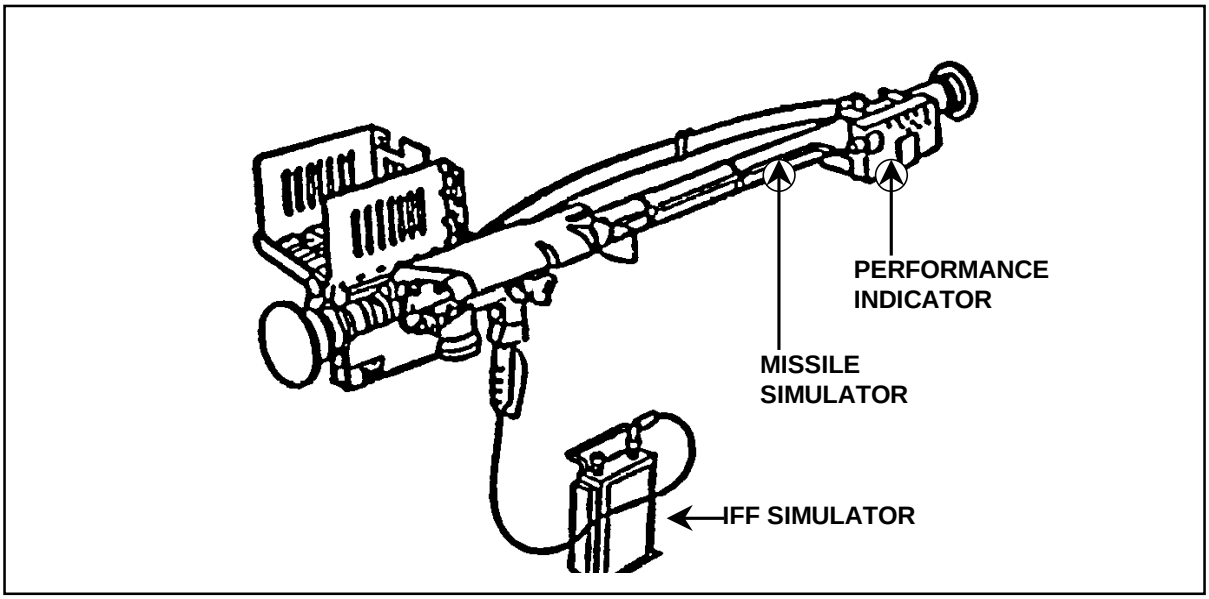


Figure 7-2. Tracking Head Trainer

STINGER TROOP PROFICIENCY TRAINER

7-4. The Stinger Troop Proficiency Trainer (STPT) is a computer-based device that generates digitized targets and background onto the weapon system's optics (figure 7-3, page 7-3). The STPT is used for realistic training of both active and reserve component Stinger gunners in a simulated wartime

environment. It eliminates the need for live aircraft, aerial targets, firing ranges, and missile expenditures. The STPT is used for training entry-level personnel and for sustainment training of engagement skills at the unit.

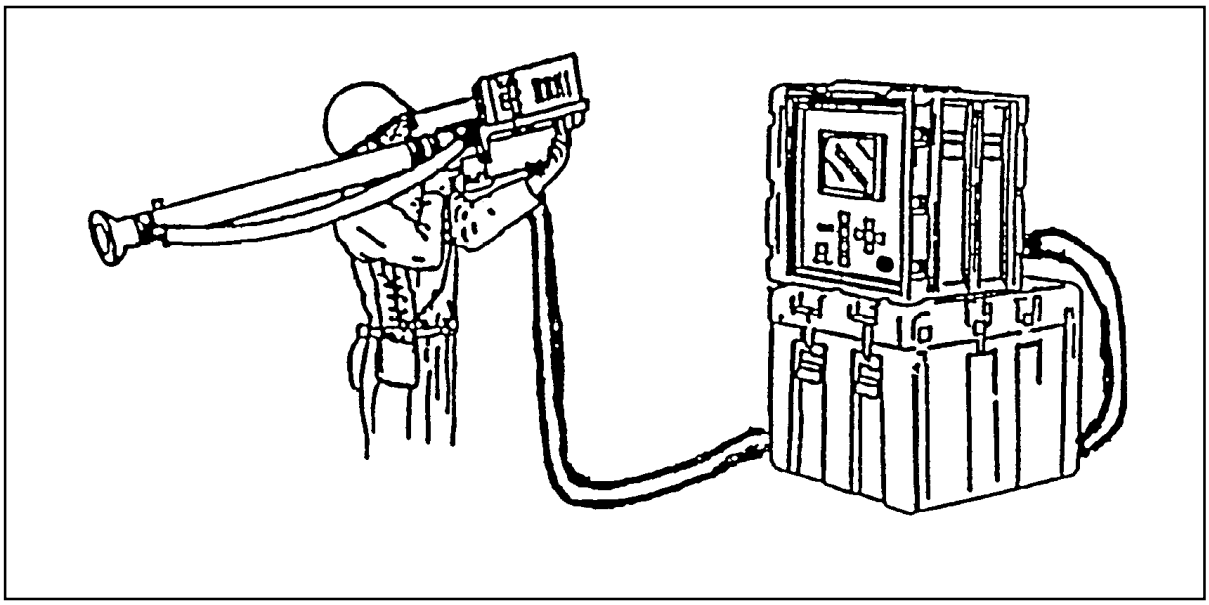


Figure 7-3. Stinger Troop Proficiency Trainer

STINGER CAPTIVE FLIGHT TRAINER

7-5. The Captive Flight Trainer is a Stinger missile guidance assembly in a launch tube. The CFT provides operator training in target acquisition, tracking, engagement, loading and unloading at the service school and sustainment training on these tasks in the unit.

STINGER IMPROVED MOVING TARGET SIMULATOR

7-6. The Improved Moving Target Simulator (IMTS), AN/FSQ-187, is a computer-driven indoor training facility. The IMTS projects battlefield background scenes and moving aircraft targets on a 360°, 40-foot diameter hemispherical dome screen to create a realistic battlefield environment.

7-7. An instructor console located in the dome controls all scenario selections for video IR projections, sound generation, target maneuvers, and countermeasures. Up to three Stinger gunners can be trained simultaneously. Student performance evaluations are possible during training exercises, using the instructor console. The IMTS is used to train Stinger gunners in target acquisition and engagement skills at the unit level, service schools and overseas commands (figure 7-4, page 7-4).

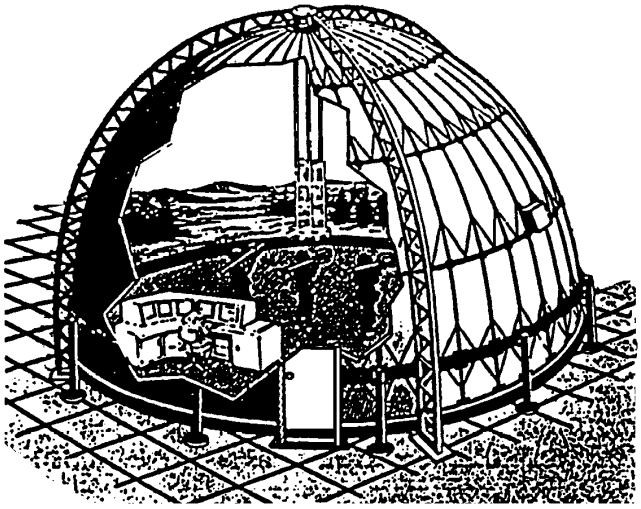


Figure 7-4. Improved Moving Target Simulator

BRADLEY STINGER FIGHTING VEHICLE/LINEBACKER TRAINING DEVICES

7-8. The following training devices are described:

- BSFV Institutional Conduct of Fire Trainer (ICOFT)
- BSFV Unit Conduct of Fire Trainer (UCOFT)
- Through Sight Video Camera
- Precision Gunnery System
- Bradley TOW Missile Simulation Round
- Linebacker Force on Force Trainer
- Captive Flight Trainer

BSFV INSTITUTIONAL CONDUCT OF FIRE TRAINER

7-9. The BSFV Institutional Conduct of Fire Trainer (ICOFT) is used strictly in the institutional training environment. The system has four crew stations controlled by a single computer system, and allows training of BSFV gunners and commanders. The ICOFT provides computer-generated scenarios of realistic battlefield video, with sound for simulated target engagements using the BSFV capabilities. The computer also provides communication with the gunner during scenarios.

BSFV UNIT CONDUCT OF FIRE TRAINER

7-10. The BSFV Unit Conduct of Fire Trainer (UCOFT) is the main device for initial and sustainment training of BSFV 25-mm gunnery skills at the unit level in CONUS and OCONUS units. It is a modular computer-based gunnery trainer for the BSFV commander and gunner. The UCOFT provides

computer-generated battlefield video scenarios with sound effects for simulated target engagements used for training and evaluation (figure 7-5).

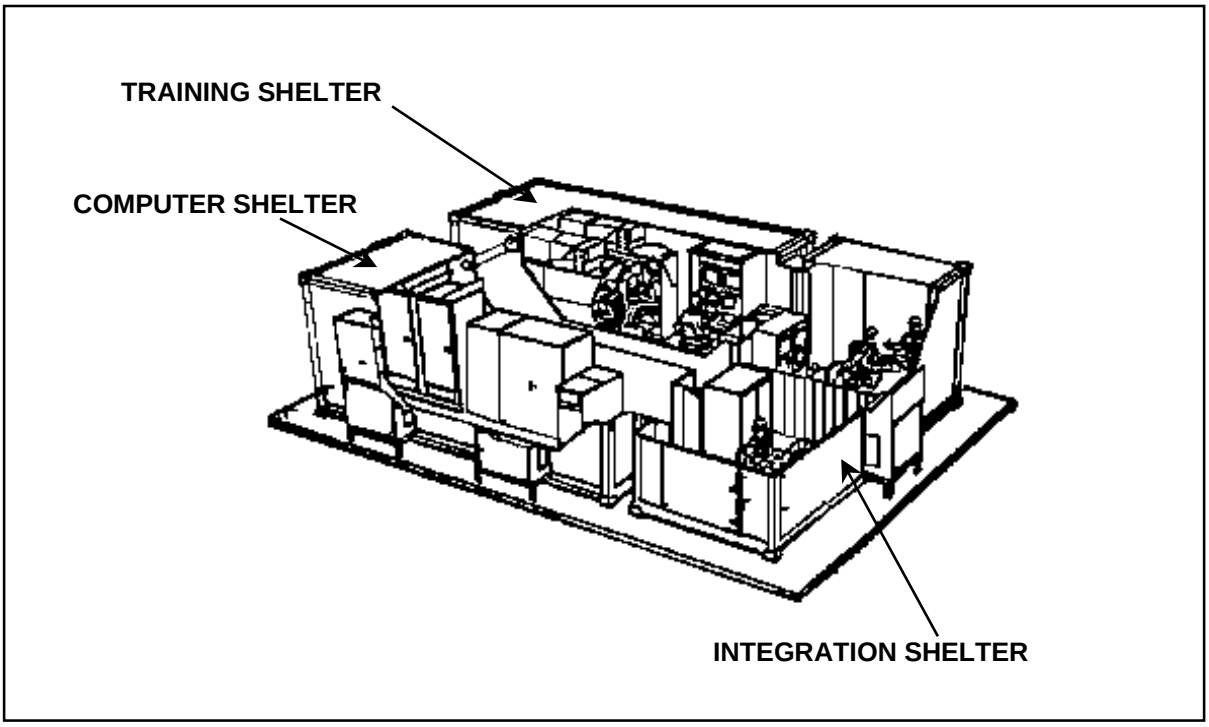


Figure 7-5. Unit Conduct of Fire Trainer

THROUGH SIGHT VIDEO CAMERA

7-11. The Through Sight Video Camera (TSVC) is a vehicle appended system that provides a video and sound recording of gunnery or tactical engagement exercises in real time. It is used in the institution and field environment for gunnery training to provide an evaluation and critique of actual engagement sequences. It provides immediate playback through use of an onboard monitor.

PRECISION GUNNERY SYSTEM

7-12. The Precision Gunnery System (PGS) is a vehicle mounted training device that improves proficiency in precision 25-mm gunnery without using ammunition. It can be used in the institution, on full-scale ranges and during tactical training exercises to train both normal and degraded modes of gunnery. It displays ballistic information for each round fired, is fully compatible with MILES and provides a review of engagements during After Action Reviews (AAR).

BRADLEY MISSILE SIMULATION ROUND

7-13. The Bradley Missile Simulation Round (MSR) is used to train Bradley crews in non-fire TOW tasks. It is the same size and weight as a real TOW

missile. It is used to practice uploading, unloading, removing misfires and storing TOW.

LINEBACKER FORCE ON FORCE TRAINER

7-14. The Force on Force Trainer (FOFT) is a training device for the Linebacker. It will be used to replicate Stinger engagements in MILES FOFT exercises. It will provide simulation of missile firings, weapon effects, signature simulation and real time target assessment. The FOFT will be used for realistic training in combat training center exercises for gunners in a simulated wartime environment.

STINGER CAPTIVE FLIGHT TRAINER

7-15. The Captive Flight Trainer is a simulated Stinger missile guidance assembly in a launch tube. The CFT will be used to provide operator training in target acquisition tracking, engagement, loading and unloading at the service school and sustain these tasks in the unit.

AVENGER TRAINING DEVICES

7-16. The following Avenger training devices are described:

- Institutional Conduct of Fire Trainer
- Captive Flight Trainer
- Force on Force Trainer
- Table Top Trainer
- Troop Proficiency Trainer

AVENGER INSTITUTIONAL CONDUCT OF FIRE TRAINER

7-17. The Avenger Institutional Conduct of Fire Trainer (ICOFT) is a computer-based device that generates digitized battlefield scenarios on video display terminals for the Avenger weapons system. The ICOFT provides full training of all target engagement tasks. Each ICOFT consists of one instructor station and six student stations. The ICOFT is primarily used to train IET enlisted students in their combat mission of target engagement, however, RC and OBC personnel are also trained using the ICOFT.

AVENGER CAPTIVE FLIGHT TRAINER

7-18. The Captive Flight Trainer (CFT) is an actual Stinger missile without the rocket motor and warhead. The guidance section provides realistic target engagement training for Avenger teams in field units.

AVENGER FORCE-ON-FORCE TRAINER

7-19. The Avenger Force-On-Force Trainer (FOFT) is an integrated laser engagement simulator used in the MILES FOFT exercises. It provides simulation of missile firings, weapons effects, signature simulation, and real time target assessment. The FOFT is used for realistic training in combat training center exercises for gunners in a simulated wartime environment.

AVENGER TABLE TOP TRAINER

7-20. The Avenger Table Top Trainer (TTT) is an interactive graphics trainer with the principle features of the Avenger turret/gunner station. A 17-inch monitor presents the out-of-window (canopy) view and the gunner's FLIR display. In addition, a FLIR field-of-view (FOV) footswitch and a tactical gunner handstation provide the gunner-machine interface.

AVENGER TROOP PROFICIENCY TRAINER

7-21. The Avenger Troop Proficiency Trainer (TPT) provides real time, free-play, and interactive simulation of stationary and remote operations. The TPT is used in conjunction with tactical equipment at unit level to train and sustain crewmember engagement skills and to train entry level personnel at the institution.

SENTINEL TRAINING DEVICES

7-22. Sentinel training devices described are:

- Sentinel Troop Proficiency Trainer
- Sentinel Institutional Maintenance Trainer
- Sentinel Training System

SENTINEL TROOP PROFICIENCY TRAINER

7-23. The Sentinel Troop Proficiency Trainer (TPT) is embedded into and used with the actual Sentinel equipment. The TPT will display incoming and outgoing information that will stimulate operator procedural actions. This will provide real time, free play interactive simulation that is representative of initialization, BIT/BITE, operations and the evaluation of data/error messages. The TPT will provide reports of operator actions and summary reports used to determine operator performance to standard.

SENTINEL INSTITUTIONAL MAINTENANCE TRAINER

7-24. The Sentinel Institutional Maintenance Trainer (SIMT) is a 3D trainer used for maintenance training. It is an institutional trainer consisting of an instructor console and four student stations. The instructor console will be able to initialize, control and monitor any combination of training stations. The SIMT is capable of training at least 100 different maintenance tasks.

SENTINEL TRAINING SYSTEM

7-25. The Sentinel Training System (STS) is capable of training students to operate the Sentinel system. The STS simulates the functional, physical operations and characteristics of the system. The Instructor/Operator Station (IOS) has the capability to interface with and control up to eight student stations to provide personnel training in the operator tasks associated with the Sentinel system. The IOS has the capability to monitor any selected student station.

FAAD C3I TRAINING DEVICES

7-26. SHORAD is a complex system of new technologies and C^3I is the glue that binds these weapons systems together. C3I provides the ADA

commander information about force operations as well as engagement operations. The FAAD C3I training devices will serve to promote C3I operators' efficiency in the tactical operations centers, A2C2, sensor C2, and battery command post nodes. The training devices described are the Institutional Conduct of Operations Trainer, and the C3I Troop Proficiency Trainer

INSTITUTIONAL CONDUCT OF OPERATIONS TRAINER

7-27. The FAADS C^3I Institutional Conduct of Operations Trainer (ICOT) is a scheduled future computer-based training device. It will simulate all software operations of the C^3I nodes (A^2C^2 BTOC, battery CP, Sensor C^2 nodes) such as air tracks, symbology, range and bearing data, weapon control orders, status's, ADW, fault simulation, BIT operations and continuous operations. Each ICOT will consist of six student stations and one instructor station. The ICOT will be used for realistic training for all C^3I operators and ADA officers. This device will train initial entry and transition personnel at the institution.

C3 I TROOP PROFICIENCY TRAINER

7-28. The C3I Troop Proficiency Trainer (TPT) is an embedded device within the system that supports a stand-alone capability to train operators to initiate and monitor critical actions. The TPT allows the operator to sustain operational skills in garrison or in the field without external training devices.

PATRIOT TRAINING DEVICES

7-29. Patriot training devices serve to train initial entry personnel and sustain unit operator and maintainer efficiency in fighting the Air Defense battle and maintaining the Patriot system's operational readiness. The training devices described are:

- Patriot Organizational Maintenance Trainer
- Patriot Conduct of Fire Trainer
- Patriot Radar Set March Order and Emplacement Trainer
- Patriot Communications System Task Trainer
- Patriot Data Link Upgrade Task Trainer
- Patriot Radar Frequency Comparator Task Trainer
- Patriot Cooling Liquid Electron Tube Removal and Replacement Task Trainer
- Patriot Antenna Element Task Trainer
- Patriot Embedded Trainers
- Patriot Empty Round Trainer
- Patriot Missile Round Trainer
- Patriot Intermediate Maintenance Instructional Trainer

PATRIOT ORGANIZATIONAL MAINTENANCE TRAINER

7-30. The Patriot Organizational Maintenance Trainer (POMT) provides a realistic static mockup of the Engagement Control Station (interior and exterior) with operator consoles interchangeable to the battalion Information

Coordination Central (ICC) configuration, and the interior and exterior of the Radar Set shelter

7-31. The POMT consists of the active maintenance trainer simulator and the parts task trainer. It is used to train maintenance personnel in the use of Display Aided Maintenance (DAM), non-display aided maintenance (non-DAM), and BITE indicator procedures to diagnose, fault locate, remove and replace defective components, and use software routines for the RS, the ECS, and ICC.

PATRIOT CONDUCT OF FIRE TRAINER

7-32. The Patriot Conduct of Fire Trainer (PCOFT) is an institutional training device for Patriot. It is a computer-driven battlefield system training device used at the USAADASCH and OCONUS. The PCOFT allows running Patriot tactical TPT software using four enhanced weapons control computer operator tactical trainers. The PCOFT has eight student consoles that are reproductions of the Patriot ECS and ICC tactical system operator consoles. One instructor station is used for controlling and monitoring the student consoles. The PCOFT is used to train battalion Tactical Directors, Tactical Director Assistants, and firing battery Tactical Control Officers and Tactical Control Assistants. Training is conducted on initialization procedures and AD battles, individually or paired Fire Unit (FU), paired battalion or netted FU, and battalion. One PCOFT can simulate up to four battalions.

PATRIOT RADAR SET MARCH ORDER AND EMPLACEMENT TRAINER

7-33. The Patriot Radar Set March Order and Emplacement Trainer (RS MO&E) trainer is an institutional training device. The MO&E trainer will be a mock-up of the Patriot RS physical characteristics as applied to MO&E tasks. The trainer consists of an RS trailer with electrical power, a rotating platform with antenna face, a shelter and outriggers.

7-34. The MO&E trainer will be used to train Patriot missile crew members, operators and system mechanics, system maintenance technicians, and AD officers in MO&E tasks. All MO&E tasks can be trained using this device instead of the tactical systems.

PATRIOT COMMUNICATIONS SYSTEM TASK TRAINER

7-35. The communication system task trainer consists of two tactical UHF radio stacks, a patch panel, an antenna control unit, three communications systems controls and a power distribution panel to provide hands-on training in initialization, operation, and maintenance of the AN/GRC-103 UHF radio communications systems.

PATRIOT DATA LINK UPGRADE TASK TRAINER

7-36. The Patriot Data Link Upgrade **(**DLU) task trainer consists of a rack of tactical DLU equipment to provide hands-on training in operation of the DLU system. Although the same basic classroom configuration as the data link terminal (DLT) used for the DLU modified DLT on the ECS, the assemblies comprising the trainer will be different. The DLU modification will add the SINCGARS radio AN/VRC-9O as the over-the-air communications link. A fiber optics unit will not be included due to its cost. Instead, the radio

transmitters will need to be loaded (dummy load) the same as the unmodified DLT. A signal will be picked up, and the signal connected to the other DLU receiver via hardwire. The DLU task trainer enables the student to perform the following emplacement tasks:

- Energize DLT module A2
- De-energize DLT module A2
- DLT power-up
- Radio AN/VRC-9O loading
- DLT self-test
- DLT synchronizing
- Security unit TSEC/KY-57 loading

PATRIOT RADAR FREQUENCY COMPARATOR TASK TRAINER

7-37. The Patriot Radar Frequency (RF) Comparator task trainer is a mockup of the tactical radar RF Comparator and consists of tactical and mockup Battery Replaceable units (BRU). The following is a list of the removal and replacement tasks that can be taught with the RF Comparator task trainer:

- Remove and replace radome with support and cooling (A139)
- Pressure switch (S1). Remove and replace
- Tube axial fan 81 or 82. Remove and replace
- Radome Feed assembly. Remove and replace
- Main Comparator horn assembly (A140) housing
- Microwave device assemblies A142, A143, or A144
- Microwave device assemblies A142, A143, or A144 air duct hose assembly

PATRIOT COOLING LIQUID ELECTRON TUBE REMOVAL AND REPLACEMENT TASK TRAINER

7-38. The Patriot Cooling Liquid Electron Tube Removal and Replacement (CLET) (R&R) task trainer is a mockup of the right rear of the RS shelter, a simulated CLET rear door, and all associated hardware to perform R&R procedures. The CLET mockup includes four coolant hoses and two electrical cables.

PATRIOT ANTENNA ELEMENT TASK TRAINER

7-39. The antenna element task trainer is a task training device used to train the removal and insertion of the individual elements in the Patriot phased array radar antenna. The radar antenna systems group diagnostics are performed using either the ECS or the POMT. Identifying particular faulty elements will be accomplished using full-scale silk screen drawings, partial scale photographs, or overhead projections of line drawing or photographs. Using one of these media in lieu of tactical equipment better fills requirements of student and instructor safety and convenience, and off-loads time from tactical equipment to training devices.

PATRIOT EMBEDDED TRAINERS

7-40. Patriot Embedded Trainers (ET) are troop proficiency trainers (TPT) with software programs that are built into the tactical system and provide training in simulated AD battle scenarios. Tactical Directors (TD), Tactical Control Officers (TCO), Tactical Director Assistants (TDA), and Tactical Control Assistants (TCA) receive sustainment training and collective training in detection, acquisition, identification, and engagement in ECM environments.

PATRIOT EMPTY ROUND TRAINER

7-41. The Patriot Empty Round Trainer (ERT) canister is a reworked expended Patriot missile round canister with appropriate markings. The ERT is used in both the institution and unit to train Patriot missile crewmembers in transporting, handling, and unloading procedures of expended round canisters.

PATRIOT MISSILE ROUND TRAINER

7-42. The Patriot Missile Round Trainer (MRT) emulates a Patriot ready-round missile in size, weight, shape, and electrical connections. The MRT is used in both institution and unit to teach Patriot missile crewmembers handling, loading, and electrical checks without using a ready round.

PATRIOT INTERMEDIATE MAINTENANCE INSTRUCTIONAL TRAINER

7-43. The Patriot Intermediate Maintenance Instructional Trainer (PIMIT) is a training device used to provide intermediate maintenance level training to students in the use of diagnostic programs, adjustments and calibration procedures, use of Test, Measuring and Diagnostic Equipment (TMDE), parts location, and troubleshooting of system malfunctions.

THAAD TRAINING DEVICES

7-44. THAAD training devices are used to support New Equipment Training (NET), institutional training, and unit training. THAAD system embedded training (ET) capabilities will be used to the maximum extent possible. The following devices are described in detail in the THAAD Operational Requirements Document (ORD):

- THAAD Institutional Conduct of Fire Trainer (ICOFT)
- THAAD Missile Round Trainer (MRT)
- THAAD Missile Round Pallet Trainer (MRPT)
- THAAD Institutional Maintenance Trainer (IMT)
- THAAD Explosive Ordnance Disposal Trainers (EODT)
- THAAD March Order and Emplacement Trainer (MOET)
- THAAD Embedded Training (ET) capability

INSTITUTIONAL CONDUCT OF FIRE TRAINER

7-45. The purpose of the ICOFT is to train THAAD personnel in the operation of system integration, hardware and software. The ICOFT will consist of three nodes, BMC3I, Radar, and Launcher. The ICOFT Control Console will

control the nodes. This training device will provide realistic institutional training for BM/C4I, Radar, and Launcher operators/crewman, and commanders and staff. The device will simulate system hardware interfaces and provides institutional training of operational functions. It will be used to train operator/maintainers on the hardware and software of the three systems segments independently, simultaneously, or collectively as an integrated system. Each of the three nodes will run tactical software (embedded training, Interactive Electronic Technical Manuals (IETM), and help aids) and replicate tactical system operations. The ICOFT nodes can be configured in all THAAD system configurations so skills learned on the ICOFT will be directly transferable to the actual system. The ICOFT also includes Part Task Trainers (PTT) to teach initial switch settings and operator/maintainer removal and replacement functions.

INSTITUTIONAL MAINTENANCE TRAINER

7-46. The IMT will provide performance – oriented maintenance/repair training. This device is designed to train critical tasks associated with diagnosis and fault isolation of the THAAD weapon system. This feature is required in order to assess the repairer's performance. The IMT must replicate the tactical system in 3-D fidelity to train all critical tasks selected by the proponent school for the device, identified to maintain the THAAD system. This device provides realistic training without, the need for large quantities of costly tactical equipment. Skills learned on this devise must be directly transferable to the tactical equipment. The IMT consists of BM/C3I, radar and launcher PTT, 3-D mock-ups of the radar Cooling Equipment Unit (CEU), and instructor stations that are interchangeable between the PTT and CEU. The IMT emulates the THAAD system by responding in the same manner and having the same performance fidelity as the objective system.

MISSILE ROUND TRAINERS

7-47. The Missile Round Trainer consist of two separate configurations, the Missile Round Pallet Trainer (MRPT) and the Missile Round Trainer (MRT). The purpose of the Missile Round Pallet Trainer (MRPT) and the Missile Round Trainer (MRT) is to train operators in the handling of the THAAD missile at the institution and unit. Both configurations are used in conjunction with the THAAD launcher for training. The MRPT and MRT will simulate the weight, balance and physical characteristics of the THAAD missile and will be used to train load/reload, hangfire and misfire procedures, and to practice missile handling and transporting procedures.

EXPLOSIVE ORDNANCE DISPOSAL TRAINERS

7-48. The purpose of this device is to train Explosive Ordnance Disposal (EOD) personnel to recognize inherent hazards associated with the components of the missile and practice EOD handling procedures. There are two (2) separate EOD trainers. They are the Practical Explosive Ordnance Disposal System Trainer (PEST) and the Classroom Explosive Ordnance Disposal System Trainer (CEST). The PEST is a full-scale inert model of the production THAAD missile and canister. The CEST is a half-scale inert model of the production THAAD missile and canister that has a cutaway of the areas containing explosive, hazardous and classified components.

MARCH ORDER AND EMPLACEMENT TRAINER

7-49. The purpose of this device is to train THAAD personnel to march order and emplace the THAAD radar. It is used in conjunction with the HEMTT tractor for training. The MOET consist of the Antenna Element (AE), Prime Power Unit (PPU), Cooling Equipment Unit (CEU), and Electronics Equipment Unit (EEU). These components are described in the following paragraphs.

7-50. **Antenna Element**. The trainer will replicate the appearance and size of the AE. The simulator will be used to train soldiers in the actual road march, march order and emplacement procedures. It will be used to train the soldiers in the proper connection of the electrical and cooling lines to the CEU, and signal data lines to the EEU.

7-51. **Prime Power Unit**. The trainer will replicate the appearance and size of the PPU. The simulator will be used to train soldiers in the actual road march, march order, and emplacement procedures. The PPU will also train the soldiers in proper connection of the electrical lines to the CEU.

7-52. **Cooling Equipment Unit**. The trainer will replicate the appearance and size of the CEU. The simulator will be used to train soldiers in the actual road march, march order, and emplacement procedures. It will train soldiers in the proper connection of the electrical and cooling lines to the AE.

7-53. **Electronics Equipment Unit**. The trainer will replicate the appearance and size of the EEU. The simulator will be used to train soldiers in the actual road march, march order, and emplacement procedures. It will train soldiers in the proper connection of the electrical, signal and data lines to the AE.

EMBEDDED TRAINING

7-54. Unit sustainment training will be accomplished through the use of an embedded Troop Proficiency Trainer (TPT) capability in the THAAD system software that simulates operational tactical battlefield information and provides training to support both Engagement Operations (EO) and Force Operations (FO). The TPT will allow operators, commanders, and staff to maintain proficiency in tactical decision making procedures and console operations. During embedded training operators will interact with the system in the same manner as they would under actual combat conditions. Training may be conducted within a single battery or battalion or concurrently with other THAAD batteries and battalions to support joint and combined training.

JOINT RADIO OPERATOR AND MAINTENANCE PROCEDURES SIMULATOR

7-55. The joint radio operator and maintenance procedures simulator (JROMPS) was developed as a cheap and versatile training device for operators and maintainers of the JTIDS radio. It emulates all functions of JTIDS through a computer link to a JTIDS mockup. JROMPS can effectively train personnel on the initialization of JTIDS, the parameters necessary for data entry, operational procedures/scenarios, automatic diagnostics and corrective maintenance.

AERIAL TARGETS FOR TRAINING

7-56. Normally, all ADA live-fire training is conducted using high performance unmanned aerial targets. These targets must be capable of simulating combat aircraft characteristics and will require the ADA weapon system to use its maximum capability. Numerous types of aerial targets, operated by troop units or furnished and operated by contract personnel, are available for ADA service practice.

7-57. Three categories of aerial targets are described in the following tables. They are drone targets, towed targets, and ballistic and troop operated targets.

DRONE TARGETS

Table 7-1. Drone Targets

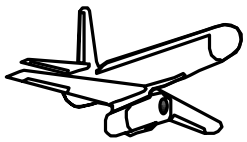
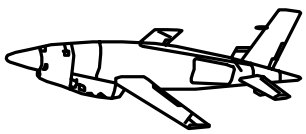
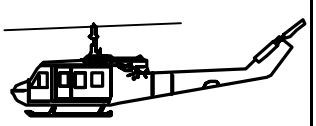
	Description	Characteristics	Augmentation
 **MQM-107 Streaker**	Subscale Subsonic Fixed wing	Speed: 250 to 500 knots Altitude: 50 to 40,000 ft Flight time: 60 minutes Guidance: command	Formation flights are possible depending on range. Scoring available. (each: $243,610) (usage fee: $9111) (scoring service: $3099)
 **BQM-34 Firebee**	Subscale Subsonic Fixed wing	Speed: 220 to 550 knots Altitude: 100 to 55,000 ft Flight time: 60 minutes Guidance: command	Formation flights are possible depending on range. Scoring available.
 **QUH-1 Huey**	Full Scale Rotary Wing Remotely Piloted	Speed: Hover/0 to 100 Altitude: 50 to 10,000 ft Flight time: 90 minutes	Infrared flare dispenser. ECM.

Table 7-1. Drone Targets (continued)

	Description	Characteristics	Augmentation
QH-50 DASH	Remote control coaxial rotor helicopter.	Speed: Hover to 80 Altitude: 0 to 16,000 ft Flight time: 1.73 hours	Infrared flare dispenser. ECM.
(Droned Anti Submarine Helicopter)			

			SU-25	MI-24	
SU-25 Frogfoot **Hind Gyrocopter**	1/5th Scale SU-25 Frogfoot & MI-24 Hind-D emulators.	Speed:	100	80 mph	MILES/AGES hit/kill smoke signal. Infrared source. Scoring available.
		Wt:	41	40 lb.	
		Endur:	30	30 min	
		Range:	3	3 Km	
		Span:	126	70 in	

TOWED TARGETS

Table 7-2. Towed Targets

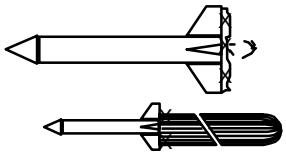
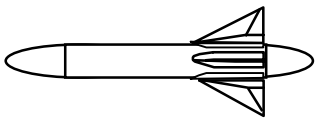
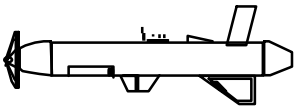
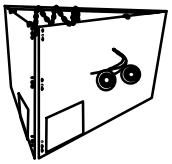
	Description	Characteristics	Augmentation
 **AGTT (Aerial Gunnery Towed Target)**	48in long, 7in diameter. Tow with a 2 ft by 12 ft multi streamered banner.	Towing provides 1 sq. meter RCS in I-band coverage	Bullet counter scoring. Towable by MQM-107 and BQM-34.
 **TRX-4A Radar Towbee**	99in long, 9in dia.	Towed from 8000 foot Towline. Provides an 8 sq. ft RCS in the X-band.	Towable by MQM-107 and BQM-34.

Table 7-2. Towed Targets (continued)

	Description	Characteristics	Augmentation
 **IRTT (Infrared Towed Target)**	85-in long by 9.5-in diameter. Propane burner provides IR. Lamp provides visual acquisition.	Towed with 600-foot towline.	Missile miss-distance scoring. Towable by MQM-107 and BQM-34.
 **Wedge**	3 ft by 4 ft wedge shape provides weapon system impact area. Stove eye burners provide IR source.	Towed from 370-foot steel cable. 2 each 110 watt stove eye burners provide IR source.	Bullet counter scoring and/or missile miss-distance scoring. Towable by QH-50.
Banner	2 ft by 12 ft mesh banner.	Towed from 600-foot towline. Presents a 1 sq. meter RCS in 8 to 10 GHz range. Visual acquisition 3 Km out.	RF reflectors. Bullet counter scoring. Towable by MQM-107 and BQM-34.

BALLISTIC AND TROOP OPERATED TARGETS

Table 7-3. Ballistic and Troop Operated Targets

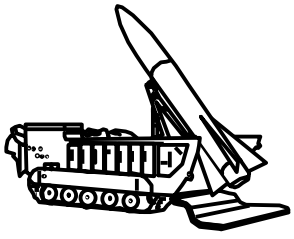
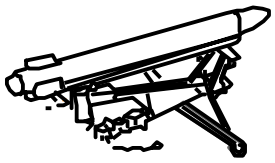
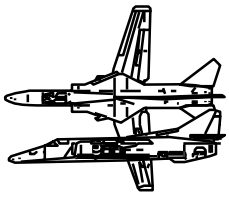
	Description	Characteristics	Augmentation
 **Lance Missile**	Targets Management Office (TMO) contractor operated only. Obsolete SS tactical missile. Emulates SCUD-B & C.	Speed: .88 to 3.6 mach Altitude: 7000 to 141400 ft Range: 130 Km Guidance: Inertial guidance and control Track Mounted or towed	Telemetry. Hit indicator.

Table 7-3. Ballistic and Troop Operated Targets (continued)

	Description	Characteristics	Augmentation
 **Ballistic Aerial Target System (BATS)**	Troop operated. Ballistic, roll stabilized, rail launched. Low to medium altitude. Emulates high performance aircraft flight profiles.	Speed: 297 to 510 knots Altitude: 1000 to 7000 ft Flight time: 47 seconds Guidance: roll and fin	IR flare scoring.
 **1/9th Scale Radio Controlled Miniature Aerial Target (RCMAT)**	Troop operated. Radio controlled, manually launched. Low altitude. Two versions emulate MIG-27 and F-16. Constructed of polypropylene foam.	Speed: 29 to 46 mph Flight time: 15 minutes Guidance: radio controlled Survivability: multiple hits from small arms	Scoring.

Appendix A

ADA Employment Principles, Guidelines, and Priorities

This appendix describes how ADA commanders use employment principles and guidelines and priority considerations to design air and missile defenses. ADA commanders at all echelons use these principles, guidelines, and considerations for AMD planning. When applying these principles and guidelines, planners must consider the tactical and technical capabilities of each weapon and sensor system as well as the relevant factors of METT-TC, IPB, and the air and missile defense priorities.

EMPLOYMENT PRINCIPLES

A-1. Commanders apply four principles when planning active air and missile defense operations. These principles are mass, mix, mobility, and integration.

MASS

A-2. Mass is the concentration of air and missile defense combat power. It is achieved by assigning enough firepower to successfully defend the force or the asset against air and missile attack or surveillance. To mass air and missile defense combat power, commanders may have to accept risks in other areas of the battlefield.

MIX

A-3. Mix is the employment of a combination of weapons systems to protect the force from the air threat. Mix offsets the limitations of one system with the capabilities of another and complicates the problem of the attacker. All joint and combined arms resources are considered when applying this principle. Proper mix causes enemy aircraft to adjust their tactics. Enemy maneuvers designed to defeat one weapon system may make an aircraft vulnerable to another weapon system.

MOBILITY

A-4. Mobility is the capability to move from place to place while retaining the ability to perform the air and missile defense mission. The mobility of air and missile defense resources must be equivalent to the mobility of the supported asset. First priority for mobility should be planning moves that support accomplishment of the mission. Tactical situations may dictate additional moves to enhance survivability.

INTEGRATION

A-5. Integration is the close coordination of effort and unity of action that maximizes operational effectiveness. Active air and missile defense operations must be integrated into the supported commander's concept of the operation. The ADA scheme of maneuver entails vertical and horizontal integration of air and missile defense systems across the width and depth of the battlefield.

EMPLOYMENT GUIDELINES

A-6. There are six employment guidelines when planning and positioning air and missile defense resources: mutual support, overlapping fires, balanced fires, weighted coverage, early engagement, and defense in depth (figure A-1).

MUTUAL SUPPORT

A-7. Mutual support is achieved by positioning weapons so that the fires of one weapon can engage targets within the dead zone of the adjacent weapon system. For gun systems the dead zone is usually small and the need for mutual support is minimal. For missile systems, especially command-guided systems, the dead zone can be large and the need for mutual support is great.

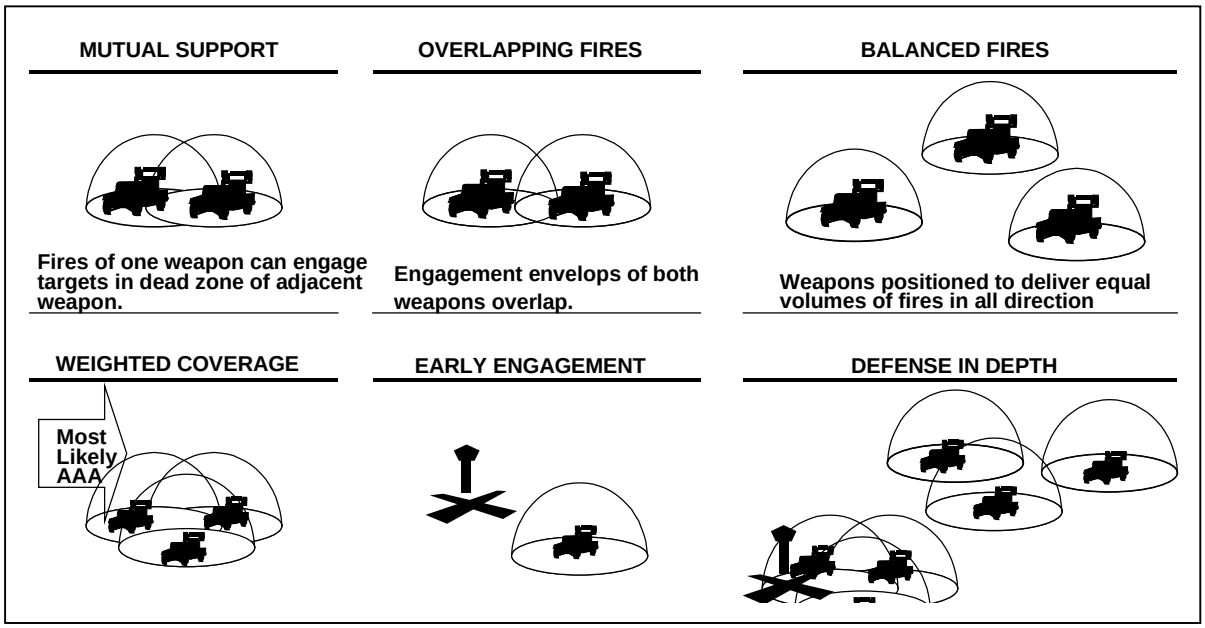

MUTUAL SUPPORT
Fires of one weapon can engage targets in dead zone of adjacent weapon.
OVERLAPPING FIRES
Engagement envelops of both weapons overlap.
BALANCED FIRES
Weapons positioned to deliver equal volumes of fires in all direction
WEIGHTED COVERAGE
Most Likely AAA
EARLY ENGAGEMENT
DEFENSE IN DEPTH

Figure A-1. Air Defense Artillery Employment Guidelines

OVERLAPPING FIRES

A-8. Overlapping fires are achieved by positioning weapons so their engagement envelopes overlap. Because of the many altitudes from which the air threat can attack, the defense planner must apply mutual support or overlapping fires vertically and horizontally.

BALANCED FIRES

A-9. Balanced fires are achieved by positioning weapons to deliver an equal volume of fire in all directions. This may be necessary when air and missile defense is used in an area where the terrain does not canalize the attacker, or when the Air Avenue of approach is not predictable.

WEIGHTED COVERAGE

A-10. Weighted coverage is achieved by combining and concentrating fires toward the most likely enemy air avenues of approach or direction of attack. Based on the tactical situation, a commander may risk leaving one direction of attack unprotected or lightly protected to weight his coverage toward another direction.

EARLY ENGAGEMENT

A-11. Early engagement is achieved by positioning weapons so they can engage the threat before ordnance release; ideally, weapons should engage and destroy the enemy before he can fire on the defended asset.

DEFENSE IN DEPTH

A-12. Defense in depth is achieved by positioning weapons so the air threat will come under an increasing volume of fire as it approaches the protected asset. Defense in depth lowers the probability that threat aircraft will reach the defended asset.

AIR AND MISSILE DEFENSE PRIORITIES

A-13. The ADA commander considers METT-TC, IPB, and the supported commander's intent and concept of operations as he develops AMD priorities. Priorities are based on the factors of criticality, vulnerability, recuperability, and the threat (CVRT). The ADA commander recommends these priorities to the maneuver commander for approval.

BLANK

Appendix B

ADA Symbols

This appendix identifies selected ADA unit symbols for use on military maps. Military symbols should contain sufficient information to clearly identify a unit, activity, or installation (FM 101-5-1). Military symbols usually consist of a basic symbol, a unit size symbol, a unit role indicator, and an equipment indicator.

UNIT SIZE AND ROLE INDICATOR

B-1. Placing the appropriate size indicator directly above the basic symbol shows the size of units. The branch or functional symbols are placed inside the basic symbol to identify the role of the unit. Symbols may be combined with one another as appropriate to show the exact function. For example, the airborne symbol is used with the ADA symbol to denote airborne ADA. Figure B-1 shows the different unit size symbols for ADA units.

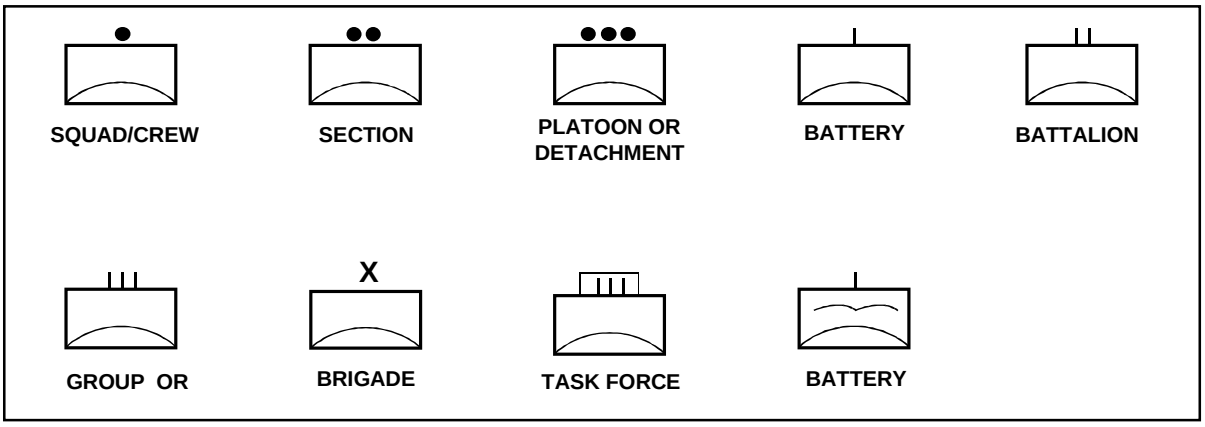


Figure B-1. Unit Size and Role Symbols

EQUIPMENT INDICATOR

B-2. Symbols are used to indicate the type and location of a weapon or group of weapons. When a weapon symbol appears on a map or overlay, the base of the shaft indicates the location of the weapon (figure B-2, page B-2).

EXAMPLES OF UNIT SIZE, ROLE, AND EQUIPMENT

B-3. Various types of ADA may be graphically represented in many ways. Figure B-3, page B-2, shows just a few of these possible combinations.

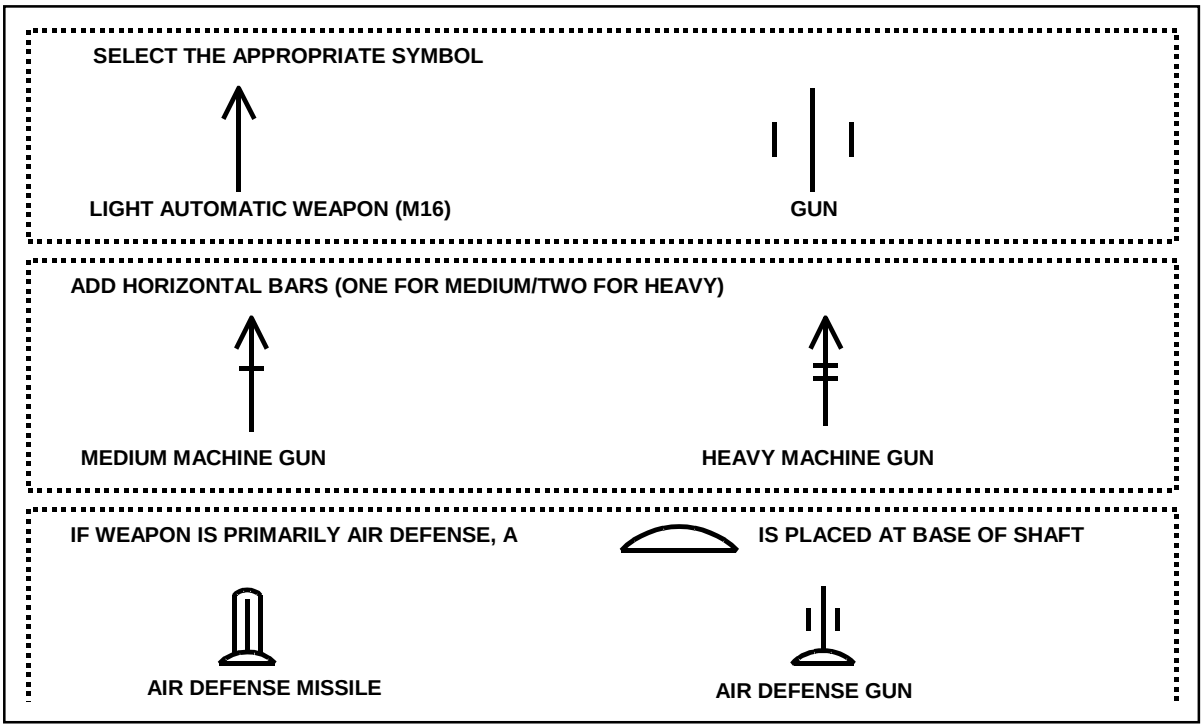

SELECT THE APPROPRIATE SYMBOL
LIGHT AUTOMATIC WEAPON (M16)
GUN
ADD HORIZONTAL BARS (ONE FOR MEDIUM/TWO FOR HEAVY)
MEDIUM MACHINE GUN
HEAVY MACHINE GUN
IF WEAPON IS PRIMARILY AIR DEFENSE, A
IS PLACED AT BASE OF SHAFT
AIR DEFENSE MISSILE
AIR DEFENSE GUN

Figure B-2. Procedure for Indicating Weapons on a Map

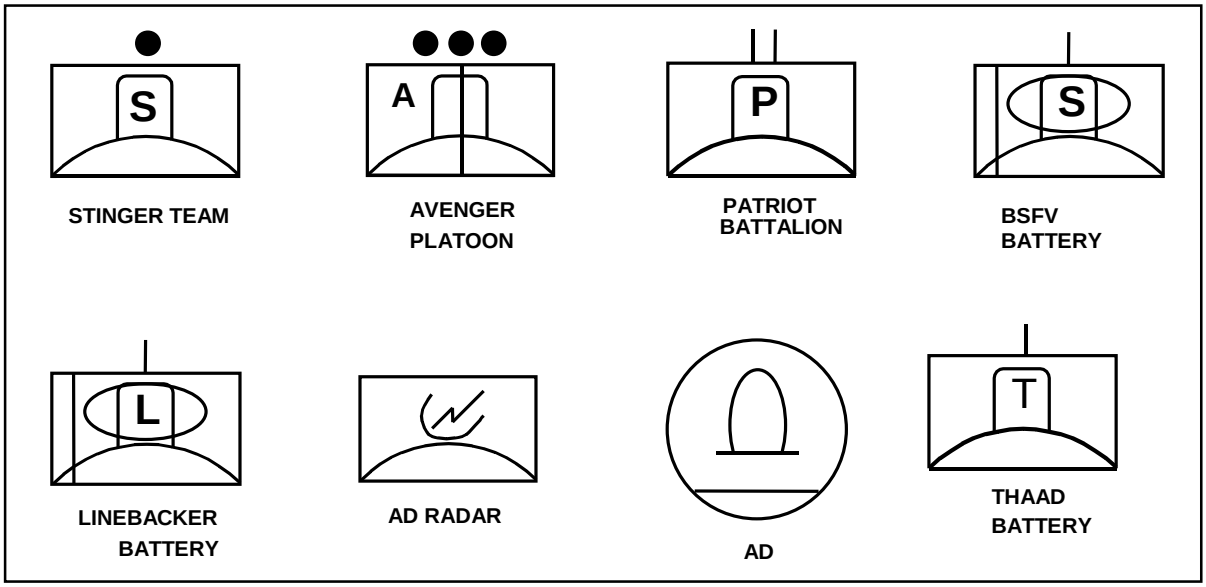


Figure B-3. Unit Size, Role, and Equipment

Glossary

A2C2	army airspace command and control
AAA	antiaircraft artillery
AADC	area air defense commander
AAMDC	army air and missile defense command
AAR	after action review
ABCS	army battle command system
ABMOC	air battle management operations center
ABT	air breathing threat
ACA	airspace control authority
ACC	air component commander
ACO	airspace control order
ACR	armored cavalry regiment
ACV	antenna cable vehicle
AD	air defense
ADA	air defense artillery
ADCN	air defense coordination net
ADCS	air defense coordination section
ADI	air defense interface
ADIZ	air defense identification zone
ADLNO	air defense liaison officer
ADOA	air defense operations area
ADSI	air defense systems integrator
ADW	air defense warning
AEU	antenna equipment unit
AGCCS	army global command and control system
AGL	above ground level
AGTS	advanced gunnery training system
AI	air interdiction
Air Defense Artillery	ground-based surface-to-air weapons, for engaging air and missile targets

air defense operations area (ADOA)	an area and the airspace above it within which procedures are established to minimize mutual interference between air defense and other operations
air interdiction	air operations conducted to destroy, neutralize, or delay the enemy's military potential before it can be brought to bear effectively against friendly forces
airspace management	the coordination, integration, and regulation of the use of airspace of defined dimensions
air superiority	that degree of dominance in the air battle of one force over another that permits the conduct of operations by the former and its related land, sea, and air forces at a given time and place without prohibitive interference by the opposing force
air supremacy	that degree of air superiority wherein the opposing air force is incapable of effective interference
ALERT	attack and launch early reporting to theater
ALOC	air lines of communications
AMC	army materiel command
AMD	air and missile defense
AMDCOORD	air and missile defense coordinator
AMDPCS	air and missile defense planning and control system
AMDWS	air and missile defense workstation
AMG	antenna mast group
AMT	avenger maintenance trainer
ANBACIS	army nuclear, biological and chemical information system
AO	area of operations
AOC	air operations center
AOI	area of interest
AOR	area of responsibility
APC	armored personnel carrier
APDS-T	armor piercing discarding sabot-tracer
APOD	aerial port of debarkation
APU	auxiliary power unit
AR	armor
area air defense Commander	within an over seas unified command, subordinate unified command, or joint task force, the commander will assign overall responsibility for air defense to a single commander

ARM	antiradiation missile
ARNG	army national guard
ARSPACE	army space command
ASAS	all source analysis system
ASAT	anti-satellite system
ASCC	army service component commander
ASCM	anti ship cruise missile
ASG	area support group
ASP	ammunition supply point
ASPO	army space program office
ATACMS	army tactical missile system
ATCCS	army tactical command and control system
ATDL	army tactical data link
ATG	antenna/transceiver group
ATGM	anti-tank guided missile
ATO	air tasking order
ATP	allied tactical publication
AV	aviation
AVT	automatic video tracker
AWACS	airborne warning and control system
A2C2	army airspace command and control
BAS	battalion aid station
BATS	ballistic aerial target system
battlefield air interdiction	air interdiction attacks against targets which are in a position to have a near term effect on friendly land forces
battlefield coordination detachment	the army liaison element collocated with the JAOC which processes land forces' requests for tactical air support, monitors and interprets the land battle situation for the JAOC, and provides the necessary interface for the exchange of current intelligence and operational data
BCD	battlefield coordination detachment
BCE	bradley control electronics
BCIS	battlefield combat identification system
BCU	battery coolant unit
Bde	brigade

BFV	bradley fighting vehicle
BIT	built-in test
BITE	built-in test equipment
BM	battle management
BMMO	battalion motor maintenance officer
BM/C3I	battle management and command, control, communications and intelligence
BM/C4I	battle management and command, control, communications, computers and intelligence
BME	battalion maintenance equipment
BMG	battery maintenance group
BN	battalion
BRU	battery replaceable unit
BSA	brigade support area
BSFV	bradley stinger fighting vehicle
BSG	beam steering generator
C2	command and control
C2W	command and control warfare
C3I	command, control, communications and intelligence
C4I	command, control, communications, computers, and intelligence
CADCI	common air defense communications interface
CAFAD	combined arms for air defense
CAP	combat air patrol; crises action procedures
CAS	close air support
CAU	crew access unit
CCIR	commander's critical information requirements
CDI	classification, discrimination and identification
CDOPS	coherent doppler scorer
Cdr	commander
CDRUSELM-NORAD	Commander, United States Element-North American Aerospace Defense Command
CDT	control display terminal
CEP	circular error probable
CEU	cooling equipment unit

CFT	captive flight trainer
CHS	common hardware software
CINC	commander in chief
CINCNORAD	Commander In Chief, North American Aerospace Defense Command
CIU	control interface unit/communications interface unit
CJCS	chairman, joint chiefs of staff
CLET	cooling liquid electronic tube
close air support (CAS)	air action against hostile tar gets which are in close proximity to friendly forces
CM	cruise missile
CMMC	corps materiel management center
CNR	combat net radio
COA	course of action
COCOM	combatant command
COFA	correlation of forces-air
COFT	conduct of fire trainer
COMARSPACE	Commander, United States Army Space Command
Command	The authority that a commander in the military service lawfully exercises over subordinates by virtue of rank or assignment. Command includes the authority and responsibility for effectively using available resources and for planning the employment of, organizing, directing, coordinating, and controlling military forces for the accomplishment of assigned missions. it also includes responsibility for health, welfare, morale, and discipline of assigned personnel.
Command and Control	The exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission.
COMM	communications van
COMMZ	communications zone
COMSEC	communications security
Control	authority less than full command exercised by a commander over part of the activities of subordinate or other organizations
CONUS	continental united states

COSCOM	corps support command
counterair operations	air operations conducted to attain and maintain a desired degree of air superiority by the destruction or neutralization of enemy air
CP	command post
CPU	control processing unit
CRC	control and reporting center
CRG	communications relay group
CRP	control and reporting post
CSA	corps storage area
CSG	corps support group
CSR	control supply rate
CSS	combat service support
CSSCS	combat service support control system
CST	crew station trainer
CTC	combined training center
Cueing	providing timely position data and with tentative identification of aircraft within a designated range of a fire unit
CZ	combat zone
DA	department of the army
DACS	divert attitude control system
DAM	display aided maintenance
DAO	division ammunition officer
DCA	defensive counter air
DCSOPS	deputy chief of staff for operations and plans
DEFCON	defense readiness condition
Defensive counterair	the protection of assets from air attack through both direct defense and destruction of the enemy's air attack capacity in the air
DEM/VAL	demonstration and validation
DIS	distributive interactive simulation
DISCOM	division support command
DISE	deployable intelligence support element
DLA	defense logistics agency
DLT	data link terminal
DLU	data link unit

DMSP	defense meteorological satellite program
DOD	department of defense
DP	decision point
DS	direct support
DSA	division support area
DSCS	defense satellite communications system
DSCSOC	defense satellite communications system operation center
DSMC	direct support maintenance company
DNVT	digital non-secure voice terminal
DSP	defense support program/direct support platoon
DSS-1	digital small switch
DSVT	digital secure voice terminal
E	east
E3A	Navy AWACS aircraft
EA	electronic attack
EAC	echelons above corps
ECCM	electronic counter countermeasures
ECM	electronic countermeasures
ECS	engagement control station
ECU	equipment coolant unit
EDR	embedded data recorder
EEFI	essential elements of friendly information
EEU	electronic equipment unit
EHF	extremely high frequency
EIU	external interface unit
electronic attack	that division of electronic warfare involving actions taken to prevent or reduce an enemy's effective use of the electromagnetic spectrum
electronic warfare	military action involving the use of electromagnetic energy to determine, exploit, reduce, or prevent hostile use of the electromagnetic spectrum and action which retains friendly use of the electromagnetic spectrum
EMCON	emissions control
EMI	electromagnetic interference
EMP	electromagnetic pulse
EN	corps of engineers

engage	a command order used to direct surface-to-air units to engage specific targets with intent to destroy
EO	engagement operations
EOD	explosive ordnance disposal
EOSAT	earth observation satellite
EP	electronic protection
EPLRS	enhanced position location reporting system
EPP	electric power plant
EPU	electric power unit
ERINT	extended range interceptor
EROS	earth resources observation system
ERT	empty round trainer
ES	electronic warfare support
ET	embedded trainer
ETPT	embedded troop proficiency trainer
EW	electronic warfare
EWCC	expanded weapons control computer
EWOPS	electronic warfare operations
FA	field artillery
FAAD	forward area air defense
FARP	forward area rearm/refuel point
FAX	facsimile
FCC	flight control center
FDC	fire direction center
FEBA	forward edge of the battle area
FEZ	fighter engagement zone
FFIR	friendly forces information requirements
FHT	field handling trainer
FID	foreign internal defense
fire support coordinator (FSCOORD)	the individual responsible for the planning and execution of fires so that targets are adequately covered by a suitable weapon or group of weapons
fire support element (FSE)	A functional element of a force command post that provides centralized targeting, coordination, and integration of fires delivered on surface targets by fire support means under the control of or in support of the force. This element is staffed from the field artillery

	headquarters or field artillery staff section of the force and representatives of other fire support means.
FLIR	forward-looking infrared receiver
FLOT	forward line of own troops
FLTSAT	fleet satellite
FLTSATCOM	fleet satellite communication system
FM	field manual
FO	force operations
FOC	flight operations center
FOFT	force-on-force trainer
FOPS	future operations van
FOS	fiber optic system
FOV	field of view
FRAGO	fragmentary order
FROG	free rocket over ground
FS	fire support
FSB	forward support battalion
FSCOORD	fire support coordinator
FSE	fire support element
FST	finance support team
FU	fire unit
FW	fixed wing
G1	assistant chief-of-staff, personnel
G2	assistant chief-of-staff, intelligence
G3	assistant chief-of-staff, operations and plans
G4	assistant chief-of-staff, logistics
GCI	ground control interception
GEM	guidance enhanced missile
GFE	government furnished equipment
GMFSC	ground mobile forces satellite communications
GMT	guided missile transporter / Greenwich mean time
GPFU	gas particulate filter unit
GPS	global positioning system
GS	general support

GS-R	general support-reinforcing
GSA	general services administration
HE	high explosive
HEI-T	high explosive incendiary-tracer
HEMTT	heavy expanded mobility tactical truck
HF	high frequency
HHB	headquarters and headquarters battery
HIDACZ	high-density airspace control zone
HIMAD	high- to medium-altitude air defense
HMMWV	high mobility multipurpose wheeled vehicle
HQDA	Headquarters, Department of the Army
HRV	high resolution visible
HSS	health service support
Hz	hertz
IAP	integrated avionics package
IBS	intelligence broadcast system
ICBM	intercontinental ballistic missile
ICC	information and coordination central
ICOFT	institutional conduct of fire trainer
ICOMS	integrated communications security
ICS	intercommunication system
ID	identification
IEA	interface electronic assembly
IEW	intelligence and electronic warfare
IFF	identification, friend or foe
IFV	infantry fighting vehicle
ILS	integrated logistics support
IMETS	integrated meteorological system
IMT	institutional maintenance trainer
IMTS	improved moving target simulator
IN	infantry
INTEL	intelligence
intelligence preparation of the	a continuous, integrated, and comprehensive analysis of the effects of terrain, weather, and enemy capabilities on operations

battlefield	
INTERCOM	intercommunications
IOS	instructor operator station
IOT&E	initial operational test and evaluation
IPB	intelligence preparation of the battlefield
IR	infrared radiation/intelligence requirement
IRBM	intermediate-range ballistic missile
IR/NUV	infrared/negative ultraviolet
ISU	integrated sight unit
J3	operations directorate
JAOC	joint air operations center
JCS	joint chiefs of staff
JDN	joint data net
JEZ	joint engagement zone
JFACC	joint force air component commander
JFC	joint force commander
JFLCC	joint force land component commander
JFMCC	joint force maritime component commander
JFSOCC	joint force special operations component commander
JICO	joint interface control officer
JOA	joint operations area
Joint Force Air Component Commander (JFACC)	The joint force air component commander's responsibilities will be assigned by the joint force commander (normally these would include, but not be limited to, planning, coordination, allocation, and tasking based on the joint force commander's appointment decision).
Joint Force Land Component Commander (JFLCC)	The designated senior land commander in a joint force who exercises command and control of all assigned land forces. based upon the joint force commander's guidance, the JFLCC develops his concept of operations, assigns missions and allocated resources. He supports subordinate units by conducting joint planning and coordination to implement their schemes of maneuver.
JOPES	joint operations planning and execution system
JOTS	joint operations tactical system
JRA	joint rear area
JSN	joint surveillance net
JSOA	joint special operations area

JSTARS	joint surveillance and target attack radar system
JTADS	joint TADIL-A distribution system
JTAGS	joint tactical ground station
JTAMD	joint theater air and missile defense
JTAR	joint tactical air request
J-TENS	joint-tactical exploitation of national capabilities
JTF	joint task force
JTIDS	joint tactical information distribution system
JTMD	joint theater missile defense
JTOC	jump tactical operations center
JTT	joint tactical terminal
JZ	joint zone
kg	kilogram
kw	kilowatt
km	kilometer
KV	kill vehicle
L	liter
LACM	land attack cruise missile
LADW	local air defense warning
LAN	local area network
LANDSAT	land satellite
LAR	logistics assistance representative
LAT	live air trainer
LAW	light antitank weapon
LB	pound
LCC	land component commander
LCD	liquid crystal display
LCR	large caliber rocket
LCS	launch control station
LCU	lightweight computer unit
LEA	launcher electronic assembly
LED	light emitting diode
LID	light infantry division
LNO	liaison officer

LOC	lines of communications (logistic routes)
LOS	line of sight
LRC	logistics readiness center
LRF	laser range finder
LRPT	large repair parts transporter
LRU	line replaceable unit
LS	launching station
LSA	logistics support analysis
LSDIS	light and special division interim sensor
LSMU	launcher and sensor mockup
LZ	landing zone
MAGTF	marine air ground task force
MANPADS	manportable air defense system
MAP	mission application program
MARFORCC	marine force component commander
MC	maintenance center
MCD	missile countermeasure device
MCO	movement control officer
MCS	maneuver control system
MCT	movement control team
MEF	marine expeditionary force
MEI	major end items
METT-TC	mission, enemy, terrain and weather, troops and support available, time available, and civil considerations
MEZ	missile engagement zone
MHz	megahertz
MICC	master information and coordination central
MILES	multiple integrated laser engagement simulator
MILSATCOM	military satellite communications
MLRS	multiple-launch rocket system
MMC	materiel management center
MOET	march order and emplacement trainer
MOPP	mission oriented protective posture
MOS	military occupational specialty

MPC	message processing center
MPH	miles per hour
MRBM	medium range ballistic missile
MRE	meals ready to eat
MRL	multiple rocket launcher
MRP	missile round pallet
MRPT	missile round pallet trainer
MRR	minimum risk route
MRT	missile round trainer
MSB	main support battalion
MSE	mobile subscriber equipment
MSI	multispectral imagery
MSR	main supply route/missile simulation round
MTOE	modified table of organization and equipment
MTW	major theater war
MWR	morale, welfare, and recreation
N	north
NAI	named area of interest
NASA	national aeronautics and space administration
NATO	North Atlantic Treaty Organization
NAVCC	navy component commander
NBC	nuclear, biological, and chemical
NCA	national command authority
NEO	noncombatant evacuation operations
NGO	non-government organization
NICP	national inventory control point
NMD	national missile defense
NORAD	north American aerospace defense command
NTC	national training center
NTDS	naval tactical data system
OAC	officers advanced course
OB	order of battle
OCA	offensive counterair
OCOKA	observation, cover and concealment, obstacles, key terrain, and

	avenues of approach
offensive counterair	an operation mounted to destroy, disrupt, or limit enemy air power close to its source as possible
OCU	operator control unit
ODD	optical disk drive
OIC	officer in charge
OLS	operational linescan system
OOTW	operations other than war
OP	observation post
OPCON	operational control
operational command	those functions of command involving the composition of subordinate forces, the assignment of tasks, the designation of objectives, and the authoritative direction necessary to accomplish the mission
operational control	synonymous with operational command
operational level of war	the level of war at which campaigns and major operations are planned, conducted, and sustained to accomplish strategic objectives within theaters or areas of operations
operations security (OPSEC)	the process of denying adversaries information about friendly capabilities and intentions by identifying, controlling, and protecting indicators associated with planning and conducting military operations and other activities
OPLAN	operation plan
OPORD	operation order
OPSEC	operations security
ORF	operational readiness float
OSI	operator system interface
PAC	patriot advanced capabilities
PADIL	patriot digital information link
PADS	position and azimuth determining system
PAO	public affairs officer
passive air defense	All measures, other than active defense, taken to minimize the effects of hostile air action. These include the use of tactical warning of air or missile attack, cover, concealment, camouflage, deception, dispersion, and protective construction.
PASR	personnel accounting and strength reporting
PCOFT	patriot conduct of fire trainer

PDU	power distribution unit
PGS	precision gunnery system
PIMIT	patriot intermediate maintenance instructional trainer
PIR	priority intelligence requirement
PJHI	PLGR/JTIDS hybrid interface
PLGR	precision lightweight global positioning system receiver
PLL	prescribed load list
PLS	palletized load system
PMCS	preventive maintenance checks and services
POD	port of debarkation
POI	program of instruction
POL	petroleum, oils and lubricants
POMT	patriot organizational maintenance trainer
positive control	a method of airspace control that relies on positive identification, tracking, and direction of aircraft within an airspace, conducted with electronic means by an agency having this authority and responsibility therein
PPI	planned position indicator
PPS	precision positioning system
PPU	primary power unit
PRM	personnel readiness management
procedural control	a method of airspace control that relies on a combination of previously agreed and promulgated orders and procedures
PSS	personnel system support
PTL	primary target line
Pub	publication
PZ	pick-up zone
R	reinforcing
R&S	reconnaissance and surveillance
RADC	region air defense commander
RC	reserve component
RCMAT	radio controlled miniature aerial target
RCS	radar cross section
RCT	remote control terminal
RCU	remote control unit

RF	radio frequency
RFI	radio frequency interference
remotely-piloted vehicle (RPV)	An unmanned aerial vehicle capable of being controlled by a person from a distant location through a communications link. It is normally designed to be recoverable.
RLRIU	routing logic radio interface unit
RMP	reprogrammable microprocessor
ROE	rules of engagement
ROTC	reserve officer training corps
ROW	rest of world
RPM	revolutions per minute
RPV	remotely piloted vehicle
RPVTS	remotely piloted vehicle trainer station
RRT	radio relay terminal
R&S	reconnaissance and surveillance
RS	radar set
RSI	radio subsystem interface
RSOP	reconnaissance, selection, and occupation of position
RSTA	reconnaissance, surveillance, and target acquisition
RSOI	reception, staging, onward-movement and integration
RSR	required supply rate
RT	return to duty/radio terminal
RTO	radiotelephone operator
rules of engagement (ROE)	Directives that delineate the circumstances under which weapons may fire at an aerial threat.
RW	rotary wing
RWCIU	radar weapons control interface unit
RWR	radar warning receiver
RWS	rigid wall shelter
S	secret/south
S1	adjutant
S2	intelligence officer
S3	operations and training officer
S4	logistics officer

SAM	surface to air missile
SATCOM	satellite communications
SCB	stinger control box
SDC	strategic defense command
SDI	strategic defense initiative
SDP	signal data processor
SDU	stinger distribution unit
SEAD	suppression of enemy air defenses
SEN	small extension node
SEP	spherical error probable
SHF	super high frequency
SHORAD	short-range air defense
SHORADEZ	short-range air defense engagement zone
SHTU	simplified hand held terminal unit
SIAP	single integrated air picture
SICC	subordinate information and coordination central
SICPS	standardized integrated command post system
SIF	selective identification feature
SIGO	signal officer
SIMT	sentinel institutional maintenance trainer
SINCGARS	single channel ground and airborne radio system
SJA	staff judge advocate
SLBM	sea-launched ballistic missile
SLC	side lobe canceller
SMU	switch multiplexer unit
SOC	sector operations center
SOE	state of emissions
SOF	special operation forces
SOJ	stand off jammer
SOJC	stand off jammer countermeasures
SOP	standing operating procedure
SOR	state of readiness
SPACECOM	space command
SPOD	sea port of debarkation

SPOT	systeme probatoire d'observation de la terre
SPINS	special instructions
SRBM	short range ballistic missile
SRPT	small repair parts transporter
SSC	small scale contingencies
SSDC	space and strategic defense command
SSI	sensor system interface
STL	secondary target line
STPT	stinger troop proficiency trainer
strategic level of war	the level of war at which a nation or group of nations determines national or alliance security objectives and develops and uses national resources to accomplish those objectives
STS	sentinel training system
STU	secure telephone unit
suppression of enemy air defenses (SEAD)	that activity which neutralizes, destroys, or temporarily degrades enemy air defenses in a specific area by physical attack and or electronic warfare
SVM	stinger vision module
SVML	standard vehicle missile launcher
TAA	tactical assembly area
TAAMDCOORD	theater army air and missile defense coordinator
TACC	tactical air control center
TACDAR	tactical detection and reporting
tactical air control center (TACC)	the principal air operations installation (land- or ship-based) from which all aircraft and air warning functions of tactical air operations are controlled
tactical level of war	the level of war at which battles and engagements are planned and executed to accomplish military objectives assigned to tactical units or task forces
TADIL	tactical digital information link
TADSS	training aids, devices, simulators and simulations
TAI	target area of interest
TASM	tactical air-to-surface missile
TBM	tactical/theater ballistic missile
TCA	tactical control assistant
TCO	tactical control officer

TCS	tactical command system
TD	tactical director
TDA	tactical director assistant
TDDS	tactical-related applications data distribution system
TEL	transporter erector launcher
TENCAP	tactical exploitation of national capabilities
TERCOM	terrain contour matching
TERS	tactical event reporting system
TES	tactical event system
TF	task force
THAAD	theater high altitude area defense
THT	tracking head trainer
TIBS	tactical information broadcast service
TM	technical manual/theater missile
TMD	theater missile defense
TMDE	test, measuring and diagnostic equipment
TNMC	tactical network mission center
TNT	troop netted trainer
TOC	tactical operations center
TOW	tube-launched, optically-tracked, wire guided (missile)
TP	tactical planner
TPT	troop proficiency trainer
TRANSCOM	transportation command
TRAP	tactical related applications
TSA	theater storage area
TSG	tactical station group
TST	troop subordinate trainer
TSVC	through sight video camera
TTT	table top trainer
TTY	teletype
TVC	thrust vector control
TVM	track via missile
UAV	unmanned aerial vehicle
UCOFT	unit conduct of fire trainer

UHF	ultrahigh frequency
UPS	uninterruptible power supply
US	United States
USA	United States Army
USAADASCH	United States Army Air Defense Artillery School
USAF	United States Air Force
USEUCOM	United States European Command
USCINCSPACE	United States Commander In Chief, Space Command
USMC	United States Marine Corps
USMTF	United states marine task force
USN	United States Navy
USPACOM	US Pacific Command
USSPACECOM	United States Space Command
USTRANSCOM	united states transportation command
UV	ultraviolet
VHF	very high frequency
VSTT	variable speed training target
W	west
WAD	weapons alert designator
WAN	wide area network
WCS	weapon control status
WEZ	weapon engagement zone
WMD	weapons of mass destruction
XO	executive officer

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